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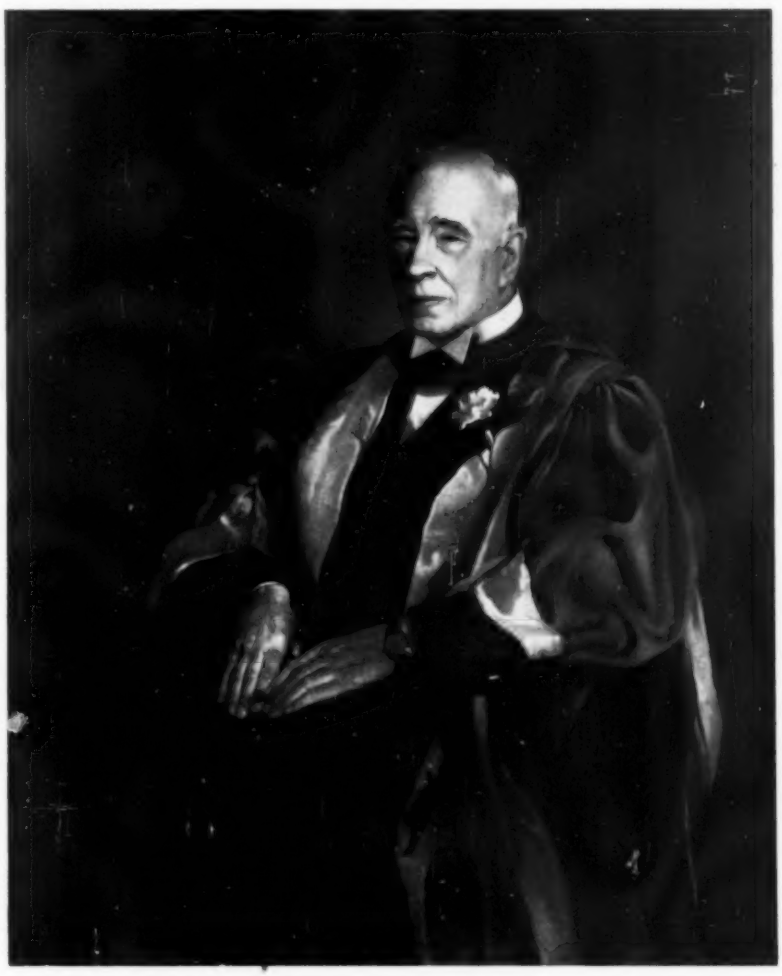
SIR GORDON GORDON-TAYLOR, K.B.E., C.B.

THE Editorial Board of the BRITISH JOURNAL OF SURGERY wishes to convey its hearty good wishes and congratulations to the doyen of British surgeons, Sir Gordon Gordon-Taylor, on his eightieth birthday. Sir Gordon has been associated with this JOURNAL since its inception in 1913 and some of his best articles have appeared within its pages. During the two world wars many outstanding contributions dealing



with the surgery of the wounded were published under his name. I cannot omit to mention the famous series of papers which he wrote for us between 1935 and 1946 on the Hindquarter Amputation, nor his article on the Surgery of the Innominate Artery, published when he was already seventy-two, but describing work in which he was actively engaged. Notwithstanding his own personal work Sir Gordon has found time to help with symposia and to re-edit articles from younger surgeons both at home and

abroad. Although this work is time-consuming yet ' G-T ', as he is affectionately called by a vast body of surgeons, undertook any amount of extra tasks without a murmur.

Sir Gordon has travelled to most parts of the world and is *au fait* with the problems which face the rising generation of surgeons. His second surgical home is perhaps in Australia, for he worked with many surgeons from Australia and New Zealand in the first world war in France, since when he has kept in touch with them and their surgical sons. The Gordon-Taylor Prize for the best candidate in the Australian Primary Fellowship examination is the most coveted of all the surgical prizes in Australia, and no wonder. With all his work in hand Sir Gordon has found time to examine for the Primary Fellowship examination for many, many years and the Royal College of Surgeons of England is ever grateful for all his help in this direction. He was already an examiner in anatomy before the first world war, and has examined for the College in Australia and New Zealand, in Egypt, India, and Ceylon, as well as at home, up till recent years.

Since the second world war Sir Gordon has devoted much time and study to the Institute of Basic Medical Sciences and has been its Vice-Dean since its formation. In spite of his many duties he has devoted much time to finding young surgeons jobs in both London and the Provinces. No one else could possibly have found places for so many young graduates in so many surgical appointments. Hundreds of young men both at home and abroad must owe Sir Gordon a great debt of gratitude for his never-faltering kindness and patient help.

Sir Gordon came to the Middlesex Hospital with a scholarship in 1898. He was already a classical graduate of Aberdeen, and through all his surgical career he has retained his love and knowledge of classical literature. We all know what a persuasive speaker and writer he is, and often envy his happy familiarity with the Latin of Horace. After qualifying in 1903, he undertook an intensive course of anatomical study, which was rewarded when he achieved first class honours in the newly instituted B.Sc. in anatomy of the University of London.

He was Consulting Surgeon to the Fourth Army in France during the first world war, after making a name for himself as a casualty clearing surgeon. He became full surgeon to the Middlesex Hospital in 1920, soon after his demobilization. In the twenty years which followed he built up a great reputation for skill and courage in tackling new surgical problems, with unwearying ardour to prolong life and effect complete cures. He was Consultant to the Royal Navy in the second world war, travelled all over the world in pursuit of his duties, and was everywhere acclaimed. The Sovereign rewarded him with Companionship of the Most Honourable Order of the Bath and a Knighthood in the Most Excellent Order of the British Empire. He was also named a Commander of the United States Legion of Merit.

At the Royal College of Surgeons of England he has been a Fellow for fifty-one years and was Vice-President fifteen years ago. He has been a Hunterian Professor on several occasions over the past forty years, delivered the Bradshaw Lecture, on the abdominal injuries of modern warfare, in 1941, and twice gave the Thomas Vicary Lecture. In this he demonstrated both his knowledge of surgical history and his abiding Scottish patriotism, speaking in 1945 about the medical and surgical aspects of the 1745 rising, and recounting in 1954 the life and work of the great London-Scottish surgeon and anatomist, Sir Charles Bell.

Sir Gordon has played a leading part in the affairs of many societies and colleges. We, his colleagues, have been eager to benefit by his wise counsel and to honour our institutions by honouring him. He has been elected an Honorary Fellow of the Irish, Australasian, Canadian, and American Colleges of Surgeons, and an Honorary Foreign Member of the Académie de Chirurgie in Paris. He is a Doctor *honoris causa* of many Universities, including Cambridge, Toronto, Melbourne, and Athens, and quite recently became an Honorary Fellow of the Faculty of Anæsthetists. He is a past President of the Association of Surgeons, of the Medical Society of London, and of the Royal Society of Medicine, which also awarded him in 1956 its coveted and rarely-bestowed gold medal.

There is a hope in all our minds and that is that Sir Gordon, a surgeon of so great experience and ability and beloved by all, and one who has lived through so progressive a period of surgical history, and has seen the art and craft of surgery at its best, will write his autobiography. We wish him very many happy returns of this birthday.

CECIL WAKELEY,
Editorial Secretary

THE SÜES: AN ILLUSTRIOUS FAMILY OF FRENCH SURGEONS

By Sir ARTHUR MacNALTY, London

THE profession of Medicine is hereditary in many families. The Vaughans number many distinguished doctors in their genealogy, including Henry Vaughan, M.D., the Silurist and poet; William Vaughan, M.D., F.R.C.P., physician to King William III and Queen Mary; Dr. James Vaughan, of Leicester, the father of Sir Henry Halford, President of the Royal College of Physicians for twenty-four years, and of Sir Charles Vaughan, M.B. (Oxon.), the first British ambassador to the United States. This tradition of illustrious service to medicine is maintained in the Vaughan family to the present day. Then there were the three generations of Monros of Edinburgh, and the Clemenceaus in France, who were doctors for three hundred years.

The subjects of this paper, the Sües, well illustrate hereditary genius. Fourteen members of the family were surgeons or physicians; several were distinguished in their profession, while one of them abandoned surgery to become a popular novelist and social reformer. An account of the family is given here as a tribute to a great surgeon and dear friend, Sir Gordon Gordon-Taylor, on his eightieth birthday.

GENERAL ACCOUNT OF THE SÜE FAMILY

The genealogical table of the Süe family is a complicated one and the complexity is increased by the fact that a number of them bore the same Christian names and have been confounded with one another in medical literature. M. Pierre Vallery-Radot in his book entitled *Chirurgiens d'Autrefois: La famille d'Eugène Süe*, published in 1944, has succeeded in unravelling this tangled skein, and with patience and care has distinguished the different branches of this illustrious family. I am obliged to M. Pierre Vallery-Radot's book and to Messieurs Ricou & Ocia, the publishers, for much information concerning the Süe family.

In the latter part of the seventeenth century in the old diocese of Vence (Var) on the borders of Provence, that land of song, fruits, and sunshine, a citizen named Süe had two sons, named Marc and Pierre Jean.

Marc Süe. This member of the Süe family was first to become a surgeon. He practised as a barber-surgeon in the small country town of La Colle situated between Vence and Cagnes. With his brother Pierre Jean, he had a large share in founding the Hospital of La Colle, which he served as one of the chief surgeons up to 1740. By his marriage with Jeanne Viany he had two children; one of these, Alexandre, followed his father's profession.

Alexandre Süe, born at La Colle in 1714, succeeded his father as surgeon to the local hospital about 1758 and served it until about 1765. In 1740 he married Catherine Gautier. They had three daughters and six sons. Two of the latter were surgeons, Jean Süe and Jean Antoine Süe.

Jean Süe, born at La Colle in 1743, served at the age of 18 in the Seven Years' War as a surgical assistant from 1761 to 1763. Later as Surgeon aide-major he served as a regimental and military surgeon for some twenty years. In August, 1792, he was appointed a surgeon to the Army of Italy, and in 1794 was *médecin-en-chef* to the Hospital of the Isle of St. Margaret. He is mentioned several times in reports as "a patriot and true republican". In spite of his long and meritorious service, when his health broke down he was not given promotion to the easier post he sought. In 1811 he retired from the Army. He died at Grasse on May 8, 1820.

Joseph Fortuné Süe, son of Jean Süe and Elisabeth Boutres, was born in 1793 in the Isle of St. Margaret. He studied medicine at Orleans, where for two years he was a pupil of his uncle, Jean Antoine Süe, at the Hôtel Dieu. In 1811, at the request of his father, he was appointed "chirurgien sous-aide-major" in the Army and served in Spain. He died there on active service in 1812 at the age of 19.

Jean Antoine Süe, the other son of Alexandre Süe to become a surgeon, was born at La Colle in 1757. In 1781 he became Master of Surgery of the Royal College of Orleans. In 1793 he was appointed aide-major of the military hospital newly established at Orleans and was surgeon to the prison there. He was also Professor of Anatomy at the Academy of Painting and Sculpture, Orleans, and Professor of Obstetrics at the Hôtel Dieu. At the age of 48 he wished to practise medicine and to that end obtained the degree of M.D. of the Faculty of Paris in 1805. His thesis was entitled: "Dissertation on hepatitis or inflammation of the liver". It was dedicated to his relative, Pierre Süe. Another medical work by J. A. Süe, published in the *Mémoires de la Société d'Émulation*, comprised "Reflections on foreign bodies arrested in the œsophagus". In 1813 he was nominated Chevalier of the Legion of Honour.

Jean Joseph Süe was the son of Jean Antoine Süe and Catherine Antoinette Pelletier and was born in Orleans in 1786. He studied at Paris under his relative Pierre Süe. Thereafter, from the age of 19 his career was that of a military surgeon in the Napoleonic wars. He was at Austerlitz, in Vienna, in the Peninsula, in the Russian campaign and retreat from Moscow, in the campaign of France (1813–14) and at the Battle of Waterloo. At the age of 26 he received the Cross of the Legion of Honour. He made several interesting observations in the course of his campaigns. In 1814 he obtained the M.D. of the University of Paris, his thesis being entitled: "Essay supported by clinical observations on biliary calculi in the gall-bladder". Exhausted by years of arduous campaigning, Dr. Süe's health broke down and in 1816 he was invalided out of the Army, suffering from pulmonary tuberculosis and attacks of hæmoptysis. In 1818 he married Louise Caroline Benoit Deshautchamps, by whom he had

three sons who died at an early age. Dr. Süe died from pulmonary tuberculosis in 1824.

Pierre Jean Süe. Having thus traced the surgeons descended from Marc Süe, we now return to his brother Pierre Jean Süe, a worthy citizen of La Colle and only moderately well-to-do. By his marriage with Margaret Bellissime he had three sons, Jean, Honoré, and Jean Joseph.

Jean Süe (1699–1762) and **Jean Joseph Süe** (1710–1792) both became Masters of Surgery and eminent surgeons in Paris. Their lives and work and those of their descendants are described later in this paper. Their brother Honoré was a tradesman at La Colle. He married Anne Marie Camin. They had two sons, Alexandre and Benoit. Alexandre married Marianne Manent and had a business at Cannes, where his son, Georges Antoine Thomas Süe, was born in 1792.

Georges Antoine Thomas Süe at the age of 17 went from Cannes to Paris to study surgery. Napoleon needed surgeons for his armies, so Georges after fifteen months of study applied for a surgical post, and in 1811 was appointed *chirurgien sous-aide-major* to the 56th Regiment of Light Infantry. After serving in Holland and on the Elbe and helped by recommendations from his cousin, Dr. Jean Joseph Süe, *secundus*, in 1812 he was appointed Surgeon of the 3rd Class to the ambulance service of the Imperial Guard and made the Russian Campaign. Under Baron Larrey he made the campaigns of Saxony and France; in 1814 he was wounded by Cossacks while defending his ambulance, and was a prisoner of war for a short time. He was next appointed surgeon to the military hospital (Maison du Roi). Being now a staunch royalist, he was dismissed during the 'Hundred Days', and was reappointed on the return of Louis XVIII. In 1816 he became M.D. of Paris with a thesis entitled: *Aperçu sur les Pneumatoses intestinales*. It was dedicated in Latin to his cousin, M. le Chevalier Süe.

Disappointed of further promotion, Süe resigned from the Army and went to Marseilles, where he practised as a physician. He was successively reporter, Secretary-General, Vice-President and President of the Royal Society of Medicine of Marseilles, chief physician of the Hôtel Dieu, Professor of Materia Medica and Therapeutics in the School of Medicine of Marseilles, and Director of the Preparatory School of Medicine and Pharmacy. He became an authority on medical administration, maintaining the dignity and rights of the medical profession in France. He made a valuable report on the cholera epidemic of 1834–35, and among other works wrote on a virulent epidemic of small-pox which attacked Marseilles in 1828, on the treatment of phthisis, and on yellow fever. He married Caroline Josephine Lavison and had children and grandchildren. He died on April 15, 1865. With the death of this distinguished physician the illustrious medical dynasty of the Sües appears to have ended.

Benoit Süe, the second son of Honoré Süe and Anne Marie Camin, was born at La Colle in 1736. Having announced his wish to be a surgeon, his uncle, Jean Joseph Süe, *primus*, summoned him to Paris, took him as his pupil at the College of Surgery, and helped him in his anatomical studies. Benoit went to the Hospital of La Charité for his clinical education, entering there at the same time as his cousin, Pierre Süe. He was appointed demonstrator of anatomy at the Hospital and assisted his uncle in the preparation of anatomical specimens.

Having qualified as Master of Surgery, Benoit went to Nantes, where he was *chirurgien aide-major* in the King's Army of the castle and the citadel. He was made Chevalier of the Hospital Order of St. Michael of Jerusalem and later received the "grand Cordon".

Being well known for his royalist sympathies, at the age of 57, in 1793, during the Terror, M. Süe was arrested, regarded as "suspect", deprived of his appointments and imprisoned at Nantes. In November, along with 131 leading citizens, he was sent under armed guard to Paris to be tried before the tribunal of Fouquier Tinville. Carrier intended the arrested persons to be either drowned or massacred on the way, but this scheme was foiled by the upright conduct of the officer in charge.

The march to Paris lasted over forty days and the prisoners suffered atrociously. Vallery-Radot gives a harrowing account of this painful Odyssey. Those who fell ill from exposure, cold, fatigue, and undernourishment were carefully tended by M. Süe, but 35 died during the journey and 3 more in the prisons in Paris to which they were sent. The fall of Robespierre in July, 1794, saved Benoit Süe from the guillotine, and in September he was acquitted by the Revolutionary Tribunal. He returned to Nantes to resume surgical practice.

Benoit Pierre Süe, the son of Benoit Süe and Jeanne Françoise Boutinot, was born at Nantes in 1776. In 1793 he was imprisoned in the Castle of Nantes, as a royalist. After his release, he entered on his hospital service, which he continued at Poitiers. In 1794 he was appointed a surgeon of the 2nd Class in the Army of Italy. From 1795 to 1797 he was a surgeon of the 3rd Class in the Army at Brest. Having qualified in surgery, he returned to Nantes, where he was surgeon to the Hospital of La Paix, formerly the Hôtel Dieu, under M. Ulliac. In 1812 he obtained the M.D. of Paris with a thesis on the "General Survey of Fractures". It was dedicated to the memory of his father and to his relative, Pierre Süe, "in friendship and gratitude". Benoit Pierre Süe sought from the Bourbons a surgical appointment in the Army at first without success. During the 'Hundred Days' he was a faithful and active royalist, and after Louis XVIII's return he was appointed surgeon-major to the 3rd Corps of Cavalry for a short time. In 1821 he was given the Legion of Honour. The rest of his life was passed in retirement at Nantes. He married in 1797 his cousin Hyacinthe, daughter of his great-uncle, Jean Joseph Süe, *primus*.

The rest of this paper is devoted to a more detailed account of five famous members of the Süe family.

JEAN SÜE

Jean, the son of Pierre Jean Süe, was born at La Colle on Dec. 10, 1699. It is likely that he had some early experience in surgery under his uncle, Marc Süe. At the age of 17 he went to Paris, where

at first he was a pupil of a barber-surgeon, an old friend of his father. Ambitious to become a surgeon, he next became a pupil of Jean Devaux, an eminent and influential surgeon. Here he had time to visit the hospitals and to study anatomy at Saint-Côme and the College of Surgery. After a long apprenticeship of thirteen years, in the course of which he passed four difficult examinations, in 1728 he became Master of Surgery of Paris.

In 1731 Louis XV, on the advice of his chief surgeon, Mareschal, created the Académie royale de Chirurgie. This gave a status to the French surgeon which was enhanced in 1743, when Louis XV by royal edict separated the surgeons from the barbers, as was done in England two years afterwards.

In 1744 Jean Süe was elected Provost (Prévôt) of the College of Surgery, a post which he held up to 1750. Here—and also as counsellor of the standing committee of the Académie royale de Chirurgie—he maintained the dignities, rights, and privileges of the surgeons in their prolonged struggle with the physicians, who endeavoured to keep them in a subordinate position. Süe had a considerable private practice, which he often limited in order to devote himself to his duties as Provost.

As a student in 1723, Jean Süe edited a large work entitled *Traitté des Principes de la Chirurgie* " fais sous Monsieur de Long chirurgien-juré de Saint-Cosmé à Paris ". He also published a botanical work, *Catalogue des Plantes usuelles dans leur État naturel, avec leurs Noms differents tant Français que Latins*, Paris, 1725, in folio.

He married in 1726 Marie Louise Le Conte. They had two children, Pierre, who followed his father's profession, and a daughter, Marie Louise. Universally honoured for his integrity, skill, and kindness, Jean Süe died in Paris on November 30, 1762.

PIERRE SÜE

Jean's son, Pierre, called Süe *le jeune* to differentiate him from his father and uncle, was distinguished as a surgeon, medical historian, and bibliophile.

Pierre Süe was born at Paris on December 28, 1739. His father as Master of Surgery had to conduct the examinations for qualification as a surgeon. He did this in his native tongue for several years, until a declaration was promulgated in 1743 stipulating that the examinations for membership of the newly constituted Académie royale de Chirurgie must be conducted in Latin. Hence Maître Jean Süe, like the celebrated J. L. Petit, found himself obliged, in spite of his mature age, to learn that language. When Pierre announced his intention of following his father's profession, Maître Jean saw that the boy was well grounded in the classical languages. He acquired an extensive knowledge of both Greek and Latin. Entering Saint-Côme in 1760 he attended the anatomical courses of his uncle, Jean Joseph Süe, *primus*, and learnt surgery in his service at La Charité.

In 1762 Pierre succeeded his father as surgeon to the city of Paris. At that time he was still only a candidate in surgery, but in the following year he was received as Master of Surgery. His thesis—*De sectione caesarea*—was published in 1766. He married in the same year Mlle. Marie Aubine Passement, the daughter of a celebrated ophthalmic surgeon; they had only one son, who died young. Pierre's wife died in 1816.

In 1767 La Martinière nominated Pierre Süe as professor and demonstrator in L'école pratique de Dissection conjointly with Lassus, another eminent surgeon. There was an unfortunate rivalry between the two professors. While both were occupied in advancing medical science, Süe sought the truth in good faith and displayed much moderation in controversy. Lassus, perhaps the more learned and brilliant man, showed excessive vanity in argument and indulged in sallies of a caustic wit.

Pierre Süe's first important medical work appeared in 1770, when he translated from Latin into French the first edition of the *Pathology* of Gaubius (1758), 1 vol. in 12. This work, although not yet completed, was adopted by the medical schools and replaced the *Pathology* of Boerhaave, " *dont beaucoup d'idées paraissent des lors surannées* ". In 1772 Gaubius brought out a second edition; and was preparing a third when he died. This third edition was published a year later in 1781 by David Hahn. Finally, Ackermann brought out a fourth edition with additions in 1787. Süe profited by these various improvements to publish a new edition of his translation which remained for many years a classic in the medical schools. In 1771 he published a *Dictionary of Surgery*, 1 vol. 8vo, which went into a second edition in 1779.

Appreciating his indefatigable zeal and attainments, the Académie royale de Chirurgie made him counsellor, commissioner for extracts and correspondence, and later its treasurer. In 1774 he became Provost of the College of Surgery.

Süe, while continuing to teach as professor at the College of Surgery, now devoted himself chiefly to literary medical researches, for which he had great aptitude. Within a little over ten years he produced an impressive number of works on medical biography and literature (*see* Appendix I). In 1790 Louis XVI nominated Pierre Süe as Professor of Therapeutics to the chair vacated by the death of Hévin, a post which he lost in August, 1793 by the suppression of the Académie royale de Chirurgie in the Revolution. In 1794 he was appointed librarian of the School of Health, afterwards the Faculty of Medicine of Paris. He may be considered as the founder of the Faculty's library, which he greatly augmented by gifts of rare books from himself and his friends. For some years he had made a special study of medical jurisprudence, and in 1800 he published a scholarly general review on the origin and subject of legal medicine. This made him an authority on the subject; and he succeeded Leclerc in the chair of legal medicine in 1808. In 1804 he had obtained the degree of M.D. Paris by examination. Pierre Süe died in Paris on March 28, 1816.

JEAN JOSEPH SÜE, *PRIMUS*

Jean Joseph, the younger brother of Jean Süe, was born at La Colle on April 20, 1710. Probably he was apprenticed first to his uncle, Marc Süe the barber-surgeon, in which capacity he showed promise and aptitude, for when he was nineteen years of age his brother called him to Paris. As a pupil of the Hôtel Dieu, Jean Joseph was singled out by Caesar

Verdier, the surgeon, who made him his assistant. Süe produced an admirable anatomical atlas with plates drawn from his dissections, and made a large collection of anatomical and pathological specimens, which his son afterwards continued and increased. He also was skilful in injection of the blood-vessels, and made a number of excellent anatomical preparations. His graduation thesis, *Sur la Cataracte*, was noteworthy and highly commended. In 1759 he

Jean Joseph Süe, *primus*, 1710–1792. (*Reproduced by kind permission of the Royal College of Physicians.*)

succeeded Verdier in the teaching of anatomy at the College of Surgery. In 1761 he became deputy to the chief surgeon at La Charité and was subsequently chief surgeon of the Hospital. He had a great reputation as a lecturer and teacher and was elected Provost of the College of Surgery in 1768.

The *Nouvelle Biographie générale* states that the Académie royale de Chirurgie, the Royal Society of London, and the Philosophical Society of Edinburgh all honoured him. The nature of the honour he is said to have received from the Royal Society is not clear. Under the engraved portrait of Süe (1775) he is described as "*membre de la Société royale de Londres*". The Librarian of the Royal Society has kindly informed me that Jean Joseph Süe's name does not appear in the Register of the Royal Society as a foreign F.R.S. or as a recipient of one of the medals. It is possible that he may have made some communication to the Society, or have been a corresponding member.

Jean Joseph Süe was royal censor for books on surgery and Professor of Anatomy at the Royal Academy of Painting and Sculpture. He wrote works on anatomy and surgery, on the technique of injecting anatomical specimens, and added notes and plates to a French translation of the *Treatise on Osteology* by Alexander Monro, *primus* (Paris, 1759), which will be discussed later.

Süe's portrait shows intelligence and determination. He was evidently a man of personality with a strong individuality. His classical features resemble those of a Roman emperor of the best period. By his work, teaching, and writings he made French surgery more scientific and comprehensive, and he deservedly won a high reputation for skill and knowledge. In 1759 Süe married Jeanne Angelique Martin de Saint Martin, widow of Louis Thévenet de Saint Arnould. By her Süe had a son, Jean Joseph, who followed his father's profession, and two daughters. The younger daughter, Hyacinthe, as previously mentioned, married her cousin, Benoit Pierre Süe, the son of her father's old pupil and collaborator. Jean Joseph Süe died in Paris on December 10, 1792, in the midst of the French Revolution, and Pierre Süe delivered a eulogy on his uncle's high moral qualities and notable services to anatomy and surgery.

THE SÜES AND THE MONROS

For centuries there has been a traditional link of friendship between France and Scotland known as *la belle alliance*. This link can also be seen in the friendly relations that prevailed between French and Scottish surgeons and anatomists in the eighteenth century.

Alexander Monro, *primus*, fostered this friendship with France. He was, stated Sir Alexander Grant, "in reality the founder of the Medical School, not only of the University, but of the City of Edinburgh", and was "the first professor of any kind who drew attention to the University of Edinburgh from without and gave it the beginnings of its celebrity".

In the beginning of the spring of 1718, Monro, who had been attending Cheselden's anatomical demonstrations in London, came to Paris to extend his medical knowledge. He attended the botanical lectures and demonstrations in the Jardin du Roy, a course of chemistry by M. Chomel, the Discourses in the École des Médecins, and the visits of the physicians and surgeons in the Hospitals La Charité and L'Hôtel Dieu. In the latter hospital he had a course of anatomy from M. Bourquet, and "performed all the operations of Surgery under the direction of M. Thibaut and of some other compagnons of that Hospital, who allowed him to examine the State of the urinary Organs of those who dyed after having undergone the operation of Lithotomy in Autumn". He also was a pupil of M. Gregoire in obstetrics and of M. Cesau for bandages. He regretted that M. Winslow gave no course of anatomy while he was in Paris. Alexander Monro then went on to Leyden to study medicine under the great Boerhaave. This *wanderjahr* no doubt assisted him greatly in his famous career, for, on his return home, after becoming a member of the Incorporation of Surgeons of Edinburgh, he was appointed Professor of Anatomy in the University of Edinburgh in 1720.

When Monro was in Paris Jean Süe had already come there to study medicine. His medical course

must have been on similar lines to that of Monro, and it is possible that the two men as fellow-students were acquainted with one another. Be that as it may, Jean Joseph Süe, *primus*, the younger brother of Jean, in later years was a profound admirer and friend of Alexander Monro, and possibly attended his anatomical lectures and demonstrations in Edinburgh. It was probably through Monro's sponsorship that he was honoured, as is stated, by the Philosophical Society of Edinburgh. *Circa* 1756, the Académie royale de Chirurgie enrolled Alexander Monro, *primus*, among their "*Membres étrangers*". In receiving this honour he obtained the support and acclamation of Jean and Jean Joseph Süe.

In 1726 Alexander Monro had published his *Treatise on Osteology* which went through several editions. As already mentioned, Jean Joseph Süe, *primus*, translated this work into French in 1759, and added notes and plates drawn from his own collection of anatomical specimens. On this work Monro commented as follows:

"Mr. Süe has made the Translation of this Treatise into French a most sumptuous Work in two large Volumes in Folio, the first is no more than the Translation with some few Notes; the 2nd Volume consists of very elegant Figures of the Bones with their Explications.—'Tis pity Mr. Süe had not the latest Edition of the English Copy that all Justice might have been done to the original Author."

However critical Alexander Monro was of J. J. Süe's translation, it had no effect on their friendly relations, for Süe sent his son Jean Joseph Süe, *secundus*, after he had taken his degree of Master of Surgery, to study under Alexander Monro, *secundus*. The *Nouvelle Biographie Générale* states that Süe obtained the degree of M.D. Edinburgh, which implies that he took the full medical course, and in M. Vallery-Radot's book he is described as "Docteur en médecine du Collège royal d'Édimbourg en 1783". I made inquiry into this when I was in Edinburgh in 1956, and by the courtesy of the Librarian of the University I was informed that Jean Joseph Süe's name does not appear in the University of Edinburgh Register as M.D. There were a number of foreign medical men who attended the Monro's lectures and demonstrations as extramural students, and Süe was probably such a postgraduate student.* He also was a devoted admirer of the Monros and, like his father, translated at least one of Alexander Monro's works into French (*The Treatise of Comparative Anatomy*, Paris, 1786).

This friendship between the two Monros and the Sües served to bring the sound anatomical knowledge of the Edinburgh School to the attention of French medical students of the eighteenth and early nineteenth centuries, and helped to enhance the high reputation which the Paris schools and hospitals attained.

JEAN JOSEPH SÜE, *SECUNDUS*†

Jean Joseph, son of Jean Joseph Süe, *primus*, was born at Paris on Jan. 13, 1760. Educated professionally chiefly by his father, he became Master of Surgery in 1781, his thesis being entitled *De Oesophagotomia*, and as we have seen, studied at Edinburgh under Alexander Monro, *secundus*, and in London attended William Hunter's course of anatomy. Returning to Paris he worked with his father at La Charité as assistant surgeon, and when his father retired in 1788 he became deputy chief surgeon to the Hospital; but saw his way barred to further promotion by the long tenure of office of Deschamps, the Chief Surgeon, and his favourite pupil, Boyer, afterwards a Baron of the Empire and Senior Surgeon to the Emperor Napoleon.

The Parisian Sües, like the Vicar of Bray, always appear to have kept on the winning side, a difficult thing to do in France in the convulsive times of the Revolution, and, subsequently, during the Directory, the Consulate, and the Restoration of the Bourbons. They seem to have avoided taking an active part in politics; and befriended by influential patients kept their professional standing and their heads.

Jean Joseph subscribed to Republican principles, and was appointed surgeon-major, first in the National Guard which was mobilized in 1792 and then in the 103rd regiment of the line. Afterwards, he was attached to the military hospital of Courbevoie.

He now became more of a physician than a surgeon. His professional skill and attainments were regarded favourably by the Emperor Napoleon who, in 1800, appointed him *médecin-en-chef* of the Imperial Guard. In this capacity, in 1812, Süe entered on the campaign in Russia, but fatigue and the rigours of the climate brought on a serious illness at Glogau in Prussian Silesia which compelled him to return to France. Here he remained an invalid for over a year, and was unable to participate in Napoleon's marvellous struggle against increasing odds in the campaign of 1813–14. Süe's health and also his wisdom did not allow him to resume professional work until the Restoration of Louis XVIII in 1814. By this time his sympathies were royalist, and in 1817 he was appointed *médecin-en-chef de la maison militaire du roi* and Chevalier of the Order of St. Michael. During the visits of the allied sovereigns to Paris, several of them, including the Emperor of Austria and the Emperor Alexander I of Russia, consulted Dr. Süe professionally and he received from them a present of costly and rare wines. Additional appointments and honours bestowed upon Dr. Süe were as follows: Professor of Anatomy at the School of Fine Arts (1819); member of the Académie de Médecine (1821); officer of the Legion of Honour (1824), and *Médecin consultant du Roi* (1824). Dr. Süe presented his

* M. Vallery-Radot states (*Chirurgiens d'Autrefois*, p. 102) that Süe on abandoning surgery for medicine had not to sustain a thesis for the degree of M.D., Paris, his Edinburgh diploma of M.D. being accepted in place thereof. Written in Latin and signed by "Jean Hardener" it is dated November 4, 1783. It seems therefore that Süe was an M.D. of Edinburgh although his name is not in the Register.

† Jean Joseph Süe, *secundus*, occasionally wrote his name as Jean Baptiste Süe—for instance, on the title-page of his thesis for Master of Surgery and on the death certificate of his first wife. This was probably done to distinguish himself from his father, Jean Joseph Süe, *primus*, but it has added to the medical historian's difficulties in differentiating the various members of the Süe family.

father's magnificent anatomical collection, which he had considerably augmented, to the School of Fine Arts, in October, 1829.

Dr. Süe was thrice married. His first wife was Mlle. Adélaide Rosalie Sauvan, by whom he had a daughter named Flore (Rose Adélaide Elisabeth), who became the wife of Dr. Guiard and died in 1833. Dr. Süe divorced his first wife on account of incompatibility of temper in the month Thermidor, year VIII of the Republic. She afterwards married M. Legouvé, by whom she had a son, Ernest, who became a friend of Eugène Süe. Dr. Süe's second wife was Marie Sophie Tison Derilly (or de Reilly). By this marriage he had two children, Marie Joseph called Eugène and Victorine who married M. Marc Desiré Caillard. Some years after his second wife's death, in 1820 he married Edmé Françoise Rosella de Milhau, a widow. By her in 1823 he had a son named Joseph Dieudonné. This son dissipated the fortune which his father left him and died in poverty in 1886 or soon afterwards. A list of Dr. Süe's principal contributions to medical literature is given in Appendix I.

DR. SÜE AND THE GUILLOTINE

In spite of having seen many tragic events, Dr. Süe prided himself on his humanitarian views. In 1796 he attacked the humanity of death by the guillotine. This method of punishment was advocated by Joseph Ignace Guillotin (1738–1814), Doctor of Medicine of Rheims and *Docteur Regent* of the University of Paris. He was neither the inventor nor a victim of the guillotine, which was only a revival of a machine used in Italy from the thirteenth century under the name of *Mannaia* for criminals of noble birth. It was known in Germany as the *Diele*, the *Hobel*, or the *Dolabra*; in Scotland as the "maiden", by which the Regent Morton suffered in 1581. Guillotin was chosen a member of the States General, and in 1789 was elected to the Constituent Assembly. He advocated there a plan for the State organization of medicine and had proposed decapitation by machine as the most humane method of execution. As a result, the guillotine became "the razor of the Revolution". Schmidt, a German, supplied the original guillotines for each of the French Departments.

Dr. Süe, in a brochure of sixteen pages entitled *Opinion du Citoyen Süe, Professeur de Médecine et de Botanique, sur le Supplice de la Guillotine* attacked this view of Dr. Guillotin, who was at this time "*médecin de la section de bienfaisance de la Halle au blé*".

Dr. Süe, who had already drawn attention to the subject in his course of lectures to medical students, maintained that anyone who suffered from an injury or wound suffered at first at the site or level of the lesion; then the brain felt painful sensations from realizing that a part of the body was suffering. Accordingly, the man who was guillotined first suffered from the cutting of the neck at the level of the section; then his brain realized that his body had suffered, and he was unable to express this suffering by complaints or outcries. Süe was convinced that, in spite of the nervous, vascular, and muscular disorders produced by the execution, the brain heard, saw, and realized the separation of mind and body, while the trunk detached from the head suffered locally. He expressed his objections to decapitation in these words:

"Je crois entendre ceux pour qui la douleur des autres n'est qu'un songe objecter que le temps du supplice étant court, la douleur doit être presque nulle. Ignorent-ils donc, ces gens apathique, qu'une douleur qui dure une seule minute est une durée incalculable pour celui qui souffre? Combien elle est plus atroce quand le patient sent qu'il a conscience de l'attendre et de l'entendre se réitérer plusieurs fois! Quelle situation plus horrible que celle d'avoir la perception de son existence et, à la suite, l'arrière-pensée de son supplice. D'après mes observations, le centre d'activité du cerveau étant considerablement augmenté, la pensée, bien loin d'être éteinte, vit tout entière, et ce qu'il y a de plus affreux pour elle, c'est que les moyens de faire juger aux assistants de son étonnante conception lui sont enlevés."

In the latter part of his treatise Süe became philosophical, specifying the different kinds of life, *la vie morale*, *la vie animal*, etc., which reunite to form one single element. He also attacked capital punishment *in toto*, saying it was astonishing in the eighteenth century that a civilized nation should not have realized the dignity of man sufficiently to feel that they had no right to take from him a life which the Creator had given him. This sentiment, if voiced by Dr. Süe in the Terror, would have got him into trouble, but it went unpunished under the milder rule of the Directory. But, in any case, Süe suggested asphyxia as less barbarous than the guillotine.

Süe's medical and philosophical contentions in this brochure did not make converts among his contemporaries, medical or lay, and the guillotine continued to be used for capital punishment.

EUGÈNE (MARIE JOSEPH) SÜE

Dr. Jean Joseph Süe was proud of the medical dynasty of the Sües. Each medical member of the family had attained a leading position in surgery in the eighteenth century, and he fervently hoped that the tradition would be maintained in the nineteenth century. It was with great joy, therefore, that he hailed the birth of a son by his second wife at No. 160, rue Neuve de Luxembourg, division de la Place Vendôme, Paris, on Dec. 10, 1804.

From the beginning Dr. Süe determined to launch his son in life under the most favourable auspices. Profiting by his good relations with the First Consul, Napoleon Bonaparte, he asked Madame Bonaparte and her son, Eugène Beauharnais, to be sponsors of the child. Not only did they consent, but they further honoured Dr. Süe by witnessing and signing the attestation of birth of the infant, who, though given the names of Marie Joseph, was always known as Eugène out of compliment to his godfather. Within a few months of the attestation, Eugène's godmother became the Empress Josephine.

Dr. and Madame Süe had produced a remarkable son, but from an early age he showed little promise of becoming like other members of his family the industrious surgeon-apprentice which his father desired. He was idle, full of mischief, a true

Parisian *gamin*, fond of playing practical jokes and thoroughly irresponsible.

Eugène was educated at the College Bourbon. At home he had a private tutor named Deltheil to supervise and assist his studies. This long-suffering man was the continual butt of Eugène and Ernest Legouvé. This behaviour and waggish humour surprised and shocked the staid physician and brought the boy into constant trouble. Though wayward and thoughtless, Eugène really admired his father. When sternly admonished by him for idleness, he would resolve to turn over a new leaf and for a time worked and behaved well. Dr. Süe seems to have doubted whether this was a real reformation. He remained severe and aloof and the wayward Eugène relapsed into his former way of life.

With a sigh, Dr. Süe renounced his hopes of a brilliant academic career for his son. Eugène wished to turn author, but like Dr. Flaubert, the father of a greater genius, Dr. Süe after hearing one of his son's stories said that if he had had to live by his pen the family would be poverty-stricken. The father was inflexible in his determination to make the son a surgeon, and decided that Eugène must now enter upon the practical side of the profession. He removed him from college before he had completed his course of rhetoric, and had him entered as an under-assistant (*sous-aide*) or apprentice-surgeon at l'Hôpital de la Maison Militaire du Roi. Here Eugène made many friends among medical students. While some of these initiated him into the delights and dissipations of Paris, others introduced him to literary and dramatic circles.

Dr. Süe employed certain students to prepare specimens and demonstrations for his courses of lectures on comparative anatomy and natural history. Among these were Ferdinand Langlé, Delatre, and Achille Petit. Eugène was expected by his father to participate in the work when he came home from the hospital, but his love of fun and mercurial disposition had a demoralizing effect upon the other assistants. When the Doctor was away at scientific meetings or at his country estate at Bouqueval, Eugène, with the connivance of the servants, entertained his friends at his father's town house (since 1806, No. 5, rue de Suresne) to pleasant little dinners and suppers. Langlé, Petit, James Rousseau, Ernest Legouvé, and Alexandre Dumas were frequent guests. Dr. Süe's most choice and costly wines, the gift of the allied sovereigns, were stored in a locked cupboard. Search was made for the key, and it was at length found hooked to the ribs of a skeleton. The bottles were opened and half their contents drunk by the young revellers. The bottles were then filled up with inferior wines and re-corked. When the doctor gave his ceremonious dinners and extolled his royal vintages, he and his guests were surprised to find how greatly their excellence had deteriorated.

Nemesis followed this exploit. One evening Dr. Süe unexpectedly appeared at his son's festal board and found the party drinking his imperial Tokay. He flew into a passion and threatened the young men with the police for breaking into his wine-cupboard, as half-sober with fright they slunk from the room. His chief wrath fell upon Eugène; and eight days later he arranged for his son to be sent to the Spanish frontier attached to the medical staff of an expedition under Dr. Gonzalés. The ostensible object of the mission was to survey the sanitary measures taken against a possible invasion of yellow fever, but it was ready, if necessary, to intervene to support the arbitrary power of King Ferdinand VII of Spain. After a few months on the frontier, Eugène was allowed to return to Paris and entered at the medical school of Val-de-Grâce.

Austria, Russia, and Prussia had formed a " Holy Alliance " to suppress, in their own interest, the ideas of liberty which the French Revolution had given to the world. The French government was ordered by the Congress of Verona (1822) to fight the Spanish liberals in Spain who had taken up arms against King Ferdinand. It was hoped that a successful expedition might give the Bourbons some military prestige, but the war from the outset was unpopular. The army was nominally commanded by the Duke of Angoulème. In March 1823 Eugène Süe joined the expedition as *aide-major* in a company of *gardes du corps*. He took part in the siege of Cadiz and the taking of the fort of the Trocadero. The casualties were light, but he had here his first experience of war surgery. The expedition was without profit or glory, but it re-established the Spanish King in his absolute power.

Returning to Paris, Eugène rejoined his friends and became a dandy and man-about-town. To support this way of life he borrowed from usurers on his expectations as heir to Dr. Süe. But one day, Alexandre Dumas relates, as Eugène drove his smart cabriolet in the Champs-Elysées, he encountered his father, who on learning of his behaviour was once more angry with him. It was clear that this disappointing son must be further disciplined. Eugène was ordered to qualify as a naval surgeon, and was appointed to the naval hospital at Toulon. The influence and recommendations of the illustrious Dr. Süe carried weight with one of the superior officers at Toulon. This was Dr. Fleury, who soon grew to like Eugène for his personal qualities, taught him a good deal of medicine and surgery, and urged him to be more industrious in his work. For a time Eugène was always to be found in the wards of the hospital; then he would flag, and be off on some expedition of pleasure, until another appeal from Dr. Fleury recalled him to his duties. Later, Eugène served as naval surgeon at Brest and L'Orient. He was only twenty-one, and when he went on leave it was always to Paris to rejoin his friends and to make little parties of pleasure. One fatal day the youthful band decided to have a picnic in the country on Dr. Süe's estate. Here the Doctor had a flock of merino sheep of which he was very proud. The revellers killed the flower of the flock and roasted it. Punishment again fell upon Eugène. Dr. Süe arranged that his son should go overseas until he came to years of discretion. Accordingly, Eugène made two voyages as ship's surgeon to the Antilles.

In 1827 the Greeks were endeavouring to gain their independence. On July 14 Eugène embarked as an auxiliary surgeon on the warship *Breslau*, commanded by the Count de la Bretonnière. The *Breslau* formed part of the French fleet sent to Greece to join with the British and Russian fleets to make a demonstration in aid of the Greeks. Owing to the

rashness of the Turkish Admiral, the unpremeditated Battle of Navarino took place on September 20, and the three allied fleets destroyed the Turkish navy. As a result, the Morea was cleared, the Greek towns liberated, and Greece regained her independence. For the Turks the battle was a carnage, a spectacle of horror. In comparison, the casualties among the allies were minimal. Eugène acquitted himself well in his duties as a naval surgeon during the battle. His station was in the cockpit of the *Breslau*; here the casualties were brought to him; and here he bound up wounds, did necessary amputations and set fractures. Süe was shocked at the carnage inflicted on the Turks, and remarked in letters to his friends that the gunpowder would have been better employed in bringing the Greek pirates to reason. In his romantic eyes the Turks seemed to him much finer fellows and more picturesque than the Greeks.

After the battle, Eugène came home on leave. Dr. Süe was pleased with him, and considered that with six years' experience he was now definitely settled in his profession. The father still kept a tight hand on the purse-strings, but he and his son were more in accord with each other than they had been. Eugène was to have a few more voyages and then to decide whether he would remain in the Navy or return to Paris to practise as a surgeon, and to lecture and hold hospital appointments in the family tradition.

On the expiration of leave, Eugène voyaged to Martinique. Here he had an attack of yellow fever and was devotedly nursed by a negress. She is supposed to have suggested the description of the negress, Cecily, in *Les Mystères de Paris*; but in the novel Cecily is a sinister character and not a kind nurse. On recovering his health, Eugène made several other voyages to French colonial possessions, collecting many impressions of tropical seas and foreign climes which he was to utilize in his romances.

In 1830, while still abroad, he received news of the death of his father in Paris on April 21; and, almost simultaneously, of the death of his maternal grandfather. Both had left him large fortunes, and Eugène decided to relinquish the profession of surgery. Loyalty to the Service delayed his resignation from the Navy, and he did not return to Paris until the following year (1831), where he found that Louis Philippe as King of the French had replaced Charles X.

The next years of Eugène Süe's life he spent chiefly as a society *flâneur* and dandy. One of his intimate friends was Count D'Orsay, who did a portrait sketch of him, and arranged for a constant supply of kid gloves to be sent to him from London. In 1839 George Feist, a German banker at Frankfurt, sending D'Orsay twelve pairs of gloves by request asked him in return to promote the sale of a special Rhine wine in London. D'Orsay promised to do so, and, in replying to Feist enclosed two letters to Eugène Süe and the Count de la Tour-du-Pin at Paris, "who will recommend your wine to real connoisseurs". When creditors compelled the Blessington-D'Orsay establishment to break up in 1849, at Lady Blessington's sale at Gore House the books sold included 37 inscribed volumes of Süe's novels.

Eugène Süe's life when he became independent was not altogether edifying, but it was redeemed by the fact that in the midst of luxury and dissipation and pose as a Byronic hero, he cultivated arts and letters as an amateur. He painted a little in his friend Theodore Gudin's studio, wrote articles in *Le Figaro* and *La Mode*, and collaborated in vaudevilles no longer remembered.

It was the epoch of the Romantic movement, strongly influenced by the novels of Sir Walter Scott. The age of Alexandre Dumas, of Balzac, of Victor Hugo, of George Sand, of Alfred de Vigny, of Stendhal, of Gerard de Nerval, and of Alfred de Musset. Charles Augustin Sainte-Beuve, who at first studied medicine like Eugène Süe, by his critical essays gave guidance and strength to this movement.

Eugène Süe also became a 'Romantic'. The adventurous sea-novels of Fenimore Cooper (*The Pilot* and *The Red Rover*) served him as a model, but he also drew largely upon his own experiences in the French Navy. *Plik et Plok* and *Kernok le pirate* (1830), his first essays in this field, were a success; then came *El Gitano*, a fantastic romance in which Süe incorporated incidents from the Spanish campaign in which he had served; *Atar-Gull* gives colourful descriptions of the Antilles; *La Salamandre*, *La Coucaratcha* (a collection of *contes*), *Voyages et Adventures sur mer de Narcisse Gelin*, *Parisien* followed. These romances appeared first as serials, chiefly in the journal *La Mode*, and were afterwards published in book form. They pleased the public, but by critics they were regarded as the work of a dilettante.

Eugène Süe at one time contemplated becoming a serious naval historian. King Louis Philippe allowed him to have access to and exceptional facilities for consulting State papers and records in the archives of the Ministry for Foreign Affairs for a "History of the French Navy in the Seventeenth Century". From 1835–37 Süe produced five volumes (with maps and plates) of the *Histoire de la Marine française, dixseptième Siècle*, Jean Bart (1658–1712), Paris. It is a romantic exposition, a series of descriptive pictures, rather than a serious historical work. So also is the *Histoire de la Marine Militaire* (1841). Süe realized his limitations as a historian, and no further volumes of the Naval History appeared.

History, however, appealed to him as a novelist, and in a quasi-historical style he wrote *Latrecumont* (2 vols., 1837) and *Jean Cavalier, ou les Fanatiques des Cevennes* (4 vols., 1840). These and other historical novels were less successful than his sea romances.

By the year 1838 Eugène by his extravagance, his dissipation, gifts of money to his friends, and the financial mismanagement of his agents, had exhausted his large fortune, and was brought to the verge of ruin. This gave him a rude but salutary shock. His houses, carriages and horses, furniture, books and objects of art were sold, and he went into retreat to retrieve disaster by his pen. "I cannot live without beautiful things," he remarked. Henceforth Süe adopted literature as his profession. But his writings, though still romantic and dramatic, became more serious, and revealed a deeper knowledge

of men and women and of the realities of life . . . *Arthur*, serialized in 1839 in *La Presse*, was described by Sainte-Beuve as a romance of distinction, deserving of as much praise for its moral perception as for its construction. *Mathilde, ou les Mèmoires d'une jeune Fille* (6 vols., 1841) depicted in lurid terms the vices of modern society in opposition to idealized characters, who were the victims or avengers of evil. In 1839 Süe was appointed Chevalier of the Legion of Honour.

For his next novel Eugène Süe decided to explore the dangerous underworld of Paris. He and his friend, Duflos, disguised themselves as French labourers in blouses, toil-stained trousers, clumsy shoes, and peaked caps. A new world of vice, poverty, hardship, drunkenness, crime, and disease was revealed to Eugène. He learned the *argot* of the slums and heard the stories of the criminals and the unfortunate. With this store of knowledge he wrote *Les Mystères de Paris*, serialized in the *Journal des Débats* (1842–43), which was an outstanding success, brought a new fortune to the author, and made him famous. Contrasting the terrible underworld with the luxury and folly of fashionable Paris, Süe wrote with burning indignation and stirred the conscience of the public concerning the evil in its midst. The success of *Les Mystères de Paris* is said to have encouraged Eugène's friend, Victor Hugo, to proceed with *Les Misérables*, a similar theme. The writing of *Les Mystères de Paris* profoundly altered Süe's outlook on life and he became a convinced Socialist. The poor and the downtrodden read his novels in feuilleton form and regarded him as their champion.

Some of the great contemporary authors could not understand Süe's popularity with his readers. Balzac and George Sand deplored his large financial gains in comparison with the sums they received for their own writings. But all agreed that he had the ear of the public. One critic observed : " Süe's style is bad, his dialogue laboured, and his popularity immense ! "

Eugène followed up his success with *Le Juif Errant*, a romance attacking the Church and the Jesuits and based on the legend of the Wandering Jew. It was published in feuilleton form in 1844–45 in *Le Constitutionnel*. For this serial Süe received a hundred thousand francs. It was praised by George Sand ; one of the male characters is a wild beast tamer, and her only complaint was that there were too many animals in it. Several of Süe's books were dramatized with success, including *Les Mystères de Paris* and *Le Juif Errant*. His later books were inferior. For example, *Les Sept Péchés Capitaux* (16 vols., 1847–49), which illustrated each of the seven deadly sins, and *Les Mystères du Peuple*, suppressed by the Censor in 1857 for immorality and sedition, were not very edifying works.

In the closing years of Louis Philippe's reign, Eugène Süe took great interest in politics, and after the Revolution of 1848, on April 28, 1850, he was elected as a democrat deputy for *La Seine* (Paris) and sat in the legislative Assembly. He opposed Napoleon III's coup d'état of December 2, and was arrested. Victor Hugo in *L'Histoire d'un Crime* refers to the prominent part Süe took in the resistance, and describes his arrest as follows :

" On the way the six prisoners, marching between a double file of bayonets, met three of their colleagues, Representatives Eugène Süe, Chanay and Benoist (du Rhône).

" Eugène Süe placed himself before the officer who commanded the detachment, and said to him—

" ' We summon you to set our colleagues at liberty.'

" ' I cannot do so,' answered the officer.

" ' In that case complete your crimes,' said Eugène Süe. ' We summon you to arrest us also.'

" The officer arrested them. They were taken to the guard-house of the Ministry for Foreign Affairs, and, later on, to the barracks of the Quai d'Orsay."

The Emperor, mindful that the Empress Josephine and Eugène Beauharnais had been Eugène Süe's sponsors, did not include his name with that of Victor Hugo and others in the list of exiles, but Süe preferred to go into voluntary exile. He settled at Annecy in Savoy, where his benevolence and charity made him beloved by the poor. He died there of cerebral hæmorrhage on Aug. 3, 1857. Eugène Süe was unmarried, and with his death this illustrious branch of the Süe family ended.

INFLUENCE OF MEDICINE IN EUGÈNE SÜE'S NOVELS

Although in his life as a naval surgeon Eugène Süe acquired considerable knowledge of his profession, he sought distinction in fiction in preference to surgery and made no contributions to medical literature. But he always recalled with pride that he belonged to a family of surgeons famous for their theoretical and clinical works.

At the same time, as with Smollett, Conan Doyle, and other ' stray-aways ' from medicine to literature, Süe's professional experience is apparent in several of his romances. Here are some instances.

In *La Salamandre*, which is the name of a French frigate, Süe gives an admirable clinical account of ' calentura ', or ' Spanish fever ', the heat-stroke associated with a thermic fever of the Tropics, which he met with during his voyages. Sambon considered that ' calentura ' was a bacillary infection, but this view is no longer accepted. Süe also utilized his experience of yellow fever in other sea-novels.

Les Mystères de Paris is partly a medical romance. In it the author discusses the " nervous fever ", described by Huxham in the eighteenth century, and also makes some observations on homoeopathy.

Perhaps, we can detect a little Süe professional arrogance in the words of Prince Rodolphe, the hero, who diagnoses Fleur de Marie's weak chest and informs Madame Georges : " I don't put great confidence in your country doctors. I will tell Murphy to bring a skilful physician, who will prescribe the proper régimen."

There are no less than four important medical characters in this book. One is the sinister Abbé Polidori, " a renowned physiologist, distinguished physician, historian, and very learned in the studies of physical and ordinary sciences ". He was Prince Rodolphe's tutor, and connived at his unfortunate secret marriage with Sarah Seyton. Fleur de Marie was their daughter. A nobler character is Rodolphe's physician, Dr. David. Originally a slave in Florida,

he was sent by his master to study medicine and surgery in Paris, where he took his medical degree with great distinction. Returning to Florida, he was once more enslaved and confined in a dungeon. From this Rodolphe rescued him, and, thereafter, David was devoted to the Prince and resuscitated him after he had nearly been drowned in a cellar by a terrible brigand. To punish this monster of crime Dr. David violates medical ethics, albeit with reluctance, and puts out the brigand's eyes at his master's orders.

A third doctor, possibly drawn from life, is Dr. Griffon, who is the scientific physician and much more interested in the disease than the patient.

" We shall have," he says, in front of the patient, " the good fortune to possess a pathological specimen of this malady." When not obsessed by scientific enthusiasm, he has a good heart. After Fleur de Marie had been nearly drowned in a river, he received her in his house and attended her.

Süe's fourth doctor is Dr. Herbin, physician to the large asylum of Bicêtre :—

" Doctor Herbin, a man of ripe age, had a highly intellectual and distinguished physiognomy, revealing remarkable sagacity and depth of thought. His smile showed the goodness of his heart. . . . He was among the first to substitute benevolent treatment for the coercive measures employed formerly ; no more chains, blows or shower-baths ; above all, no more solitary confinement."

Süe gives a good description in his novel of different types of insanity and of the epilepsy of the Marquis d'Harville which he had transmitted to his daughter. Here Süe depicts the tragedy of inherited disease.

In *Le Juif Errant* there is a venal doctor named Baleinier. He has been initiated into the Order of the Jesuits, and at their bidding abducts Adrienne, a wealthy heiress, and immures her in his private asylum. He does this from compulsion, and is quite relieved when she is rescued and restored to her freedom. The book also contains a lurid description of the cholera outbreak in Paris :—

" To add to the confusion and consternation of the populace, the most absurd and groundless stories were circulated abroad that the patients in the hospitals were being poisoned, so that they might be got rid of to make room for other patients ; and the maddened and infuriated populace vowed vengeance against the doctors. The streets of Paris swarmed with vile wretches who plundered and maltreated unprotected persons, and entered the plague-stricken houses and robbed them of whatever they could lay their hands on. Thus was this gay city the scene of the most revolting and horrifying spectacles imaginable."

It was also alleged that the cholera epidemic was brought about by persons poisoning the water-supplies of Paris. Süe employs this belief to dispose of two of his characters by mob violence.

Enough has been said to indicate Eugène Süe's knowledge of medicine in his romances. He also remembered enough surgery to save himself from undergoing a mutilating operation. In the early years of his exile at Annecy he was attended by Dr. Bouvier for a painful swelling of the tongue. Dr. Gensoul, a surgeon, was summoned in consultation, diagnosed cancer and advised removal of part of the organ. Eugène Süe refused to accept the diagnosis, Dr. Gensoul departed much annoyed, and the condition eventually cleared under Dr. Bouvier's therapeutic treatment.

On the whole, Dr. Jean Joseph Süe's insistence on his son's becoming a surgeon helped to some extent in the making of the future popular novelist.

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This book gives a full and detailed account of the fourteen medical members of the Süe family, including an account of the family connexions of Eugène Süe. Those desiring further information about these distinguished surgeons and their times should consult this authoritative work.

APPENDIX I

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Works of Jean Süe, *primus* :—

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Plan pour les Leçons anatomiques à donner aux Élèves de l'Académie, 1747.

Abrégé d'Anatomie, 2 vol. in 12 (2 editions, 1748 and 1754).

Dissertation sur l'Osteologie relative à la Peinture et à la Sculpture, Paris, 1749.

Sur la Cataracte, Paris thesis, 1751.

Traité d'Ostéologie de Monro, traduits de l'Anglais, 2 vol. folio, Paris, 1754.

Éléments de Chirurgie, Paris (2 editions, 1755 and 1774).

Anthropotomie ou l'Art d'Injecter, de disséquer, d'embaumer et de conserver les Parties du Corps humains, Paris, 1759.

Works of Pierre Süe :—

De Sectione caesarea, Paris thesis, 1763.

Notes sur les Aphorismes de Boerhaave, commentés par van Swieten, Paris, 1768.

Pathologie de Gaubius, Paris, 1769.
Dictionnaire portatif de Chirurgie (being vol. III of Dictionnaire de Santé), Paris, 1771, 1777, 1783.
Éloge historique de M. Devaux, avec des Notes, Paris, 1772.
Éléments de Chirurgie en Latin et en Français, avec des Notes, Paris, P 1774, 1783.
Éloge de Louis XV, Paris, 1774.
Extrait de Mémoires littéraires et critiques sur la Médecine, Paris, 1776.
Lettre critique à Jean Goulin sur l'État de la Médecine en France, Paris, 1776.
Mémoire sur l'Aneurisme de l'Artère crurale, Paris, 1776.
Précis historique sur la Vie et les Ouvrages de Passement, ingenieur du roi, pour servir de supplément à l'Article qui le concerne dans le Dictionnaire des Artistes, *avec une Notice des plusieurs Artistes anciens, omis dans cet Ouvrage*, Paris, 1778.
Essais historiques, littéraires et critiques sur l'Art des Accouchements, Paris, 1779 (2 volumes).
Discours sur les sujets de Prix relatif à l'Hygiène chirurgicale proposés par l'Académie de Chirurgie de 1775 à 1783, Paris, 1784.
Anecdotes historiques, littéraires et critiques sur la Médecine, la Chirurgie et la Pharmacie, Amsterdam and Paris, 1785 (2 volumes).
Examen d'un Ouvrage intitulé, Nouvelles Instructives de Médecine, Chirurgie, etc., Paris, 1786.
Séance publique de l'Académie de Chirurgie du 17 Avril, 1793, Paris, 1793.
(This contains two notes, one on *Antoine Louis*, the other on *Les Frères Süe*.)
Discours sur la Bibliographie médicale, Paris, 1796.
Éloge de P. I. Poissonier, Paris, 1798.
Aperçu général, appuyé de quelques faits sur l'Origine et le Sujet de la Médecine legale, Paris, 1800.
Mémoire sur la Vie et les Ouvrages du Professeur Jean Goulin, Paris, 1800.
Histoire du Galvanisme et Analyse des différents Ouvrages publiés sur cette Decouvéte, Paris, 1801–2 (2 volumes) and 1805 (4 volumes).
"This work had a great success and largely contributed to facilitate researches on this important branch of physics." (*Nouvelle Biographie Générale.*)
Mémoire sur l'État de la Chirurgie à la Chine, Paris, 1802.
Commentaire littéraire sur quelques Passages des Lettres de Sénèque le Philosophe relatifs à la Médecine, Paris, 1802.
Éloge de Bichat, Paris, 1803.
Sur quelques Maladies des Os, Paris, 1803.
Éloge historique de P. Lassus, Paris, 1808.

Pierre Süe was also author of a part of Vols. VI and VII of the *Commentaires de van Swieten*, translated from the Latin, and he published with additions the *Pratique moderne de la Chirurgie* by Ravaton, Paris, 1777 (4 volumes). He drew up and commented on analytical tables for various works of Buffon, of Lavater, and of Cabanis. He translated into French from the Latin the *Surgical Works of Louis (Laurent) Heister, First Physician to the Duke of Brunswick*, but the manuscript was unpublished.

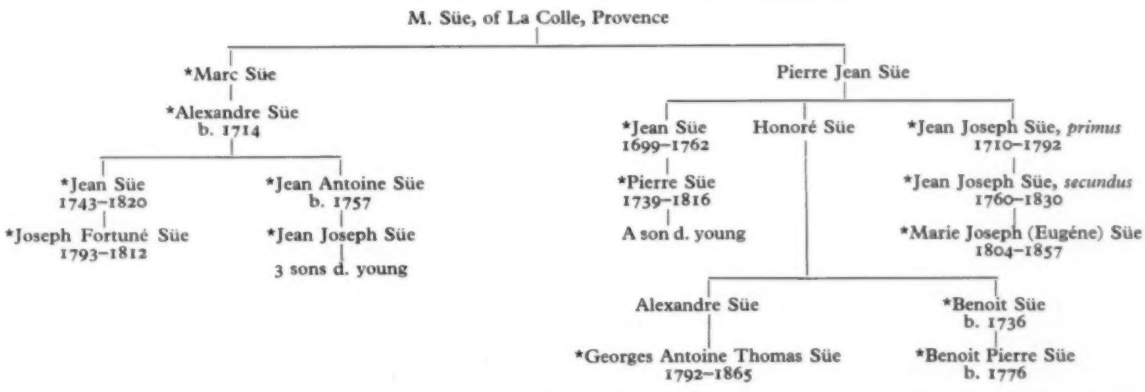
Works of Jean Joseph Süe, *secundus* :—

Programma de Oesophagotomie, Paris thesis, 1781.
(The title-page gives the author's name as *Joannes-Baptista Süe, Parifinus.*)
Traduction du Traité d'Anatomie comparée d'Alexandre Monro fils, Paris, 1786.
Éléments d'Anatomie à l'Usage des Peintres, des Sculpteurs et des Amateurs, Paris, 1788 ; 2nd ed., 1805.
Opinion du Citoyen Süe, Professeur de Médecine et de Botanique, sur le Supplice de la Guillotine, ou sur la Douleur qui survit à la Decollation, Paris, 1796.
Essai sur la Physiognomie des Corps vivants considerés depuis l'Homme jusqu'à la Plante, Paris, 1797.
Essai sur la Physiognomie, Paris, 1797.
Recherches physiologiques et Expériences sur la Vitalité et le Galvanisme, Paris, 1797.
His cousin, Pierre Süe, also wrote on this subject (*see* reference above).

Note : Reference is made to the chief contributions to medical literature of other members of the Süe family in the text of this paper.

APPENDIX II

GENEALOGICAL TABLE OF THE SÜE SURGEONS



Note : The fourteen members of the family who were members of the medical profession are marked with an asterisk.

RECOLLECTIONS OF AN APPRENTICE

By E. W. RICHES, The Middlesex Hospital

To serve as an assistant to an accepted Master of Surgery is the greatest privilege to which a young surgeon can aspire. It gives him the opportunity of learning to treat his patients as human beings, of acquiring a surgical technique which respects human tissues, of becoming imbued with enthusiasm for his work, and of realizing that he must devote himself wholeheartedly to it if he, too, is to become a master. It is one of the advantages of our system of surgical apprenticeship that a newly qualified doctor can act as assistant to a surgeon of world eminence. To be loyal to a chief is taken for granted, but for those who have had the great good fortune to serve as House Surgeon to Sir Gordon Gordon-Taylor such loyalty is almost overshadowed by the respect, admiration, and affection which he engenders in all who work for and with him.

The recollection of being his house surgeon in 1926 is still vivid, but a perusal of the case records of his patients at that time has brought back some almost forgotten details of that exciting six months and has emphasized some of the changes which have taken place in surgical practice in thirty-two years.

At that time the hospital surgeon was truly a general surgeon, and Gordon-Taylor was both able and willing to tackle any surgical problem. The only full surgical specialists on the hospital staff were the gynæcologists, the ear, nose, and throat surgeons, the orthopædists, and the ophthalmic surgeons, and whilst Gordon-Taylor was always ready to call in his specialist colleagues he was equally at home in dealing with most of the conditions which they would now be expected to treat. Even dental extractions, necessary before the excision of a cancerous tongue in a patient with severe oral sepsis, were often carried out by the firm, following the experience that staged removals more frequently left a living patient than wholesale clearances; these were discreetly entered on the list of operations for the day as 'Examination under Anæsthetic'.

In gynæcology he was influenced by the work and example of Bland-Sutton, and there were not a few cases of hysterectomy; patients with acute salpingitis or ruptured ectopic gestation were regular surgical emergencies. In the throat he would excise a malignant tonsil and the faucial pillars with a wedge from the mandible, after a preliminary block dissection of the neck. A man with a carcinoma of the pyriform fossa was treated by the excision of the primary growth and the glands in the neck *en bloc*; he had a tracheotomy and was fed through an œsophageal tube, although he still got a great deal of enjoyment from washing out his mouth with beer or soup and emitting it into a basin.

In 1926 fractures did not go automatically to the orthopædic surgeon; a fractured olecranon was wired, and an ununited tibia plated by Gordon-Taylor with all the skill of the modern bone expert. For the removal of a large cancellous osteoma of the humerus in a man of 18 he did not consider the hospital chisels strong enough and arrived in the operating theatre with a 12-in. cold chisel bought from the local ironmonger for two shillings. His pioneer work in the development of the hindquarter amputation is well known throughout the world, and his cases of this formidable procedure exceed in number the years of his life. Even ophthalmic surgery was not entirely sacrosanct and there was at least one case of advanced sarcoma of the orbit treated by wide diathermy excision.

Plastic surgery was of recent development and we had no special department for it; the pedicle graft was no mystery to Gordon-Taylor, and whenever a carcinoma of the cheek was excised, and they were not infrequent, a full-thickness forehead graft, already lined with skin, was ready to fill the gap. Nor was thoracic surgery a separate entity except in contemplation; rib resection for empyema was a house surgeon's operation, but removal of the œsophagus for malignant disease was a surgical ambition, and the establishment of this operation on the footing it now holds was largely due to his pioneer attempts made at this time. Neurosurgery was in its infancy, but Gordon-Taylor was prepared to resect the Gasserian ganglion for trigeminal neuralgia; it fell to the house surgeon to trephine the skull so that the more delicate approach to the nerve could be made by the steady hands of the surgeon.

There was already at Middlesex a department of Urology established by Mr. (now Lord) Webb-Johnson, but Gordon-Taylor had a great interest in urological cases. He stimulated his house surgeon to a similar interest by presenting him, on the day of his appointment, with a cystoscope; mine is still in use. Patients with disease of the urinary tract were investigated by what were then the modern methods; they included cystoscopy, examination of the urine from each kidney, and retrograde pyelography; intravenous or excretion pyelography had not yet been devised. For exposure of the kidney he preferred to use Newman's triple pneumatic cushion to the rigid kidney bridge; the incision was that of Morris, but part of the twelfth rib was excised when necessary for better exposure. Stones were removed from a horseshoe kidney in a man of 34; he left hospital healed on the twentieth post-operative day. After pyelolithotomy the pelvis was usually left unsutured. A ureteric calculus was passed after catheterization of the ureter; a small papilloma of the bladder was treated by diathermy through the cystoscope, but there was a readier tendency to perform open excision of a larger papillary tumour than there is to-day. Frank carcinoma was treated by partial cystectomy, with re-implantation of the ureter into the bladder when necessary, and suprapubic drainage by a large tube was the rule after all bladder operations. For prostatectomy the two-stage Freyer operation was adopted, but normal micturition was expected within three weeks. Inflammatory stricture of the urethra was common and internal urethrotomy was shown to be a satisfactory operation; both the house surgeon and the dressers had ample opportunities to learn the art of urethral dilatation.

Apart from these excursions into the surgical specialties it is as a general surgeon that Gordon-Taylor excelled, and it is problematical whether his work in the head and neck, the abdomen, or the breast should take pride of place. Patients with carcinoma of the tongue or mouth were numerous; radium was still on trial, and even though some local successes had been achieved by it the problem of invaded glands in the neck remained. For Gordon-Taylor the condition was surgical and the notes of an actual case give an idea of the treatment he carried out.

A. B., male, aged 51 had an ulcer on the left side of the tongue for three months.

On examination there is an ulcer with a hard base and well-defined edges on the left side of the tongue and floor of the mouth. The teeth are in an appalling condition and his breath is positively foul. On each side there is an enlarged gland in the submaxillary region and on the left side other glands are affected.

Expiration is prolonged and there are rhonchi at both bases.

April 13, 1926: Under gas and ether 15 teeth were removed, from the left side.

April 20: Remaining teeth removed.

April 29: Under cervical block and ether. Block dissection of the left side of the neck. Sections show secondary deposits of squamous-cell carcinoma in the jugulodigastric gland.

May 12: Preliminary tracheotomy for anæsthetic. Anterior 4 in. of alveolar margin of the lower jaw removed by circular saw and chisel, and the anterior nine-tenths of the tongue removed by diathermy.

Section shows invasion of the tongue by keratinizing squamous carcinoma.

June 1: Discharged convalescent.

June 23: Readmitted. Modified block dissection of right cervical glands. Section shows no neoplastic invasion.

July 6: Discharged.

When seen five years later the man was well and free from recurrence.

Block dissection on the affected side of the neck was always radical and included the internal jugular vein; it was an excellent lesson in anatomy, a subject in which the surgeon was an expert.

The use of tracheotomy or laryngotomy as a preliminary to operations on the mouth was the rule; it lessened the anæsthetic problems and gave the house surgeon experience in this operation. Many of the cases of cancer of the tongue were advanced, and some had been exacerbated by the previous application of caustic. It was remarkable how well they overcame their subsequent disability after extensive excision of the tongue and learned to speak intelligibly.

In the abdomen Gordon-Taylor was an early advocate of gastrectomy for gastric and duodenal ulcer and was prepared to excise a malignant stomach in a stage which many surgeons of the day would have considered inoperable. A man of 49 made a good recovery after removal of a large part of the stomach containing a malignant ulcer involving the omentum and necessitating the removal of the middle of the transverse colon. Too many of the patients with abdominal cancer, however, were received at a late stage when metastases were already present and it was not uncommon to find multiple peritoneal nodules or metastases in the liver at laparotomy. The regret with which the abdomen was closed with the patient unrelieved was apparent to all in the theatre.

An acute abdominal emergency would always attract Gordon-Taylor himself whatever the hour of the night. A woman of 24, the cook to one of the anæsthetists, was admitted with sudden acute abdominal pain which came on as she was getting into bed. Before the morning she had undergone resection of 14 in. of gangrenous ileum which had suffered volvulus from a band attached to a caseous mesenteric gland. She made a complete recovery. A boy of 16 was admitted on a Sunday evening with acute intestinal obstruction; at laparotomy the same evening an enteric intussusception was resected; it contained a lymphosarcoma at the apex. Paul's tubes were inserted into each end of the small bowel and two days later continuity was restored by closure and side-to-side anastomosis. He was discharged well on the nineteenth day.

There were many patients with carcinoma of the breast; the standard treatment was radical amputation which included the removal of both pectorals and a thorough clearance of the axilla. A ten-year survival rate of 84 per cent in Stage I cases justifies the method of treatment.

At that time there were wards in the Cancer Wing into which patients in such an advanced stage as to be deemed incurable were admitted, and where they could remain until relieved by art or released by death. There was thus ample opportunity to see the effects of this disease in its late and painful stages and to add further justification, if such were needed, to attempts at its radical extirpation whilst it was still operable.

Anæsthetics: Gordon-Taylor was well served by excellent anæsthetists, amongst whom Raymond Apperly and Harold Crampton were outstanding. Ether and chloroform were still the most widely used anæsthetics and post-operative pulmonary complications were common. It was for this reason that for most of the major abdominal operations the general anæsthetic was supplemented by an abdominal field block and splanchnic anæsthesia introduced from behind, or later on by the surgeon himself from in front after the abdomen had been opened. These measures certainly helped to bring many patients safely through a complicated operative procedure, but the surgeon could never waste time and Gordon-Taylor always despised the surgical sluggard.

The chief post-operative complication in the elderly man was bronchopneumonia; had modern chemotherapy or antibiotics been available there would undoubtedly have been a lower mortality rate, but in their absence brandy was considered a most useful post-operative remedy.

Blood transfusions were given fairly frequently, although not on the present scale. From his wide experience in the first World War Gordon-Taylor considered that whole blood, unadulterated by anticoagulants, gave the best results, and transfusions were therefore done with the Kimpton tube. The house surgeon was responsible for sterilizing the tube and coating it inside with a smooth lining of paraffin wax of uniform thickness to prevent clotting. The cutting down method was essential both for taking and giving the blood, and the operation

required much practice and some luck. I was fortunate in having over me as registrar my colleague Rupert Vaughan Hudson; he helped me to avoid letting the side down. There were also two successive teams of hard-working dressers, many of whom have now attained high positions in their profession. The whole firm served the chief with implicit confidence and loyalty. He was bold and courageous but never reckless; inspiring, devoted to his work, his patients, and his hospital; outspoken but never discourteous, and generous to a degree. It will always be a proud boast to say "I was Gordon-Taylor's house surgeon". Of the 40 who served him in this office from the year 1920, when he came on the full staff, until his retirement in 1939, no less than 25 attained consultant status, of whom 12 were appointed to his own hospital of Middlesex; this record must surely be unique.

MALIGNANT SPINAL TUMOURS AND THE EPIDURAL SPACE*

By LAMBERT ROGERS, Cardiff

A study of malignant tumours occurring within the vertebral canal adds to our knowledge of the course of some forms of malignant disease and at the same time presents us with some problems relating to the anatomy and pathology of the spinal epidural space, which appear to be peculiar to it. Both primary and secondary malignant tumours, either of which may be extra- or intrathecal, occur in the spinal canal, but the commonest of the malignant tumours are metastatic and lie outside the dura in the epidural space.

THE EPIDURAL SPACE

Less attention has been given to this space than its clinical importance would appear to warrant. It has no corresponding counterpart in the skull, where, except when hæmorrhage has forced the dura away from the inner table, there is merely a potential space, the dura being closely applied to the inner surface of the bone, somewhat loosely over the vertex but firmly and with adhesive to the base.

The spinal epidural space is a true space inasmuch as the back and sides of the spinal dura mater are separated by an interval from the walls of the spinal canal. This interval is comparatively constant in the thoracic and lumbar regions but in the cervical region varies in its anteroposterior extent with flexion and extension of this part of the spine.

In transverse section the space is crescent-shaped, being obliterated anteriorly by the roots of the issuing nerves and the anterior surface of the dura which above the second sacral vertebra is closely applied to the posterior longitudinal ligament and the backs of the vertebral bodies. Below the second piece of the sacrum the space surrounds the dural tube. When at laminectomy the space is entered it is seen to be limited in front of the bluish dura mater overlain in the cervical region by a little loose areolar tissue and elsewhere in the spinal canal by a thin, pale layer of fat; otherwise, its contents are a number of veins. Anatomists make no mention of either lymphatics or lymphatic-nodes in the epidural space, and Field and Brierley (1948) find that the regional nodes of the spinal subarachnoid space are prevertebral.

The space may be the site of either benign or malignant primary tumours, metastatic tumours, pus, granulation tissue, deposits of lymphadenoma, and occasionally hæmorrhage. Extradural spinal hæmorrhages are rare, however, when compared with similar intracranial lesions and few cases have been reported, the most recent being by Alderman in the United States (1956), who was able to find only 14 other recorded cases, 3 of which, including his own, were due to dicoumarol therapy. The commonest primary tumours to occupy the space are neurinomas, lipomas (arising from the epidural fat), hæmangiomas, and plasmocytomas, and it may be encroached upon by tumours arising in the vertebræ such as osteoclastomas, while the metastatic tumours most often found in it arise in breast, prostate, lung, thyroid, and other organs.

A curious feature of tumours found in the epidural space is the ease with which they may be stripped through a line of cleavage from the external surface of the dura mater, whereas inflammatory deposits such as granulation tissue and chronic abscesses are firmly adherent to the dura and cannot be separated from it by blunt dissection (Rogers, 1957a).

MALIGNANT TUMOURS

In a series of 329 laminectomies which I have now performed, 109 were for tumours of the spine, the cord, or its meninges, and 51 of the tumours were malignant in character; 22 (43 per cent) were metastatic.

Whether malignant disease involves the cord by compression or by infiltration it causes interference with its property of conduction and, in many cases also, pain from involvement of nerve-roots. Although in such cases prognosis is necessarily grave, something can often be done for those so afflicted, pain being alleviated, and sometimes, though not so often as we could wish, function being improved or restored.

In reviewing the malignant tumours some common characteristics are noticeable. First, their curious predilection for the epidural space. This probably depends on the presence of the vertebral veins with their rich, valveless ramifications and connexions, which Batson (1940, 1942) has so correctly described as constituting a venous lake in which it would appear a malignant embolus might remain and develop without being propelled onwards to the heart. This fact, combined with the absence of lymphatic-nodes in the space, suggests that the metastatic tumours are blood-borne. In support of this, also, Willis (1952) remarks on the occurrence

* From the Surgical Unit, The Welsh National School of Medicine, The Royal Infirmary, Cardiff.

of cuffs of tumour cells which are sometimes seen accompanying blood-vessels into the brain or cord. This is still further supported by the occasional presence of a densely sclerosed vertebral body in cases of prostatic cancer (see the case of the blacksmith, aged 58, on p. 420). It is well known that big veins, occasionally a large group of them, enter the backs of the vertebral bodies through large foramina which are sometimes multiple and can be seen on the posterior aspects of certain vertebræ and an embolic deposition in a vertebra so supplied might well give rise to the sclerotic appearance. (*Fig.* 457.)

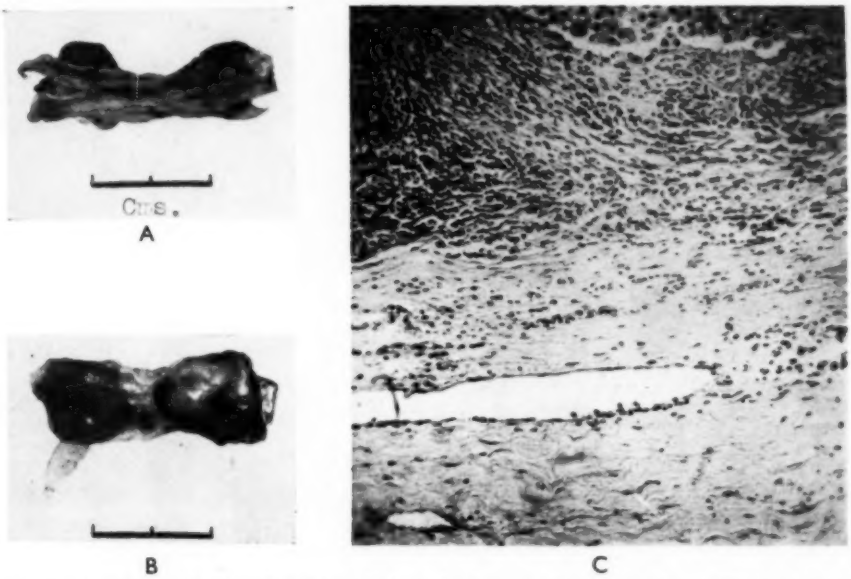


FIG. 452.—Metastatic tumour of right adrenal in spinal subdural space of a man aged 54. The tumour was adherent to the dura and at operation resembled a meningioma. A, Seen from dural aspect; B, Seen from within the theca; C, Microscopical appearance. (× 80.) Wt. of tumour 2·7 g.

Secondly, the insulating effect of the spinal dura, which forms a protective barrier between even the most extensive and highly malignant tumour and the intrathecal contents, the dura appearing to be very rarely if ever invaded or penetrated.

Thirdly, the ease, to which reference has already been made, with which such tumours can be stripped from its surface. This is so characteristic that until the pathologist's report was available I was puzzled by one case in which what appeared to be a secondary bronchial carcinoma failed to strip away from the dura. There was no line of cleavage such as I had always found in epidural neoplasms.

The patient was a man of 68 who was paraplegic and from whose left main bronchus pus was seen to be escaping. At laminectomy a grey tumour was found in the epidural space, high in the thoracic region, associated with a similar tumour in the left sacrospinalis at the same level. These tumours proved, however, to be inflammatory tissue and not neoplasms. After the operation he recovered from his paraplegia.

Chronic inflammatory tumours of this type are rare, but have been recorded by Dandy (1926) and others.

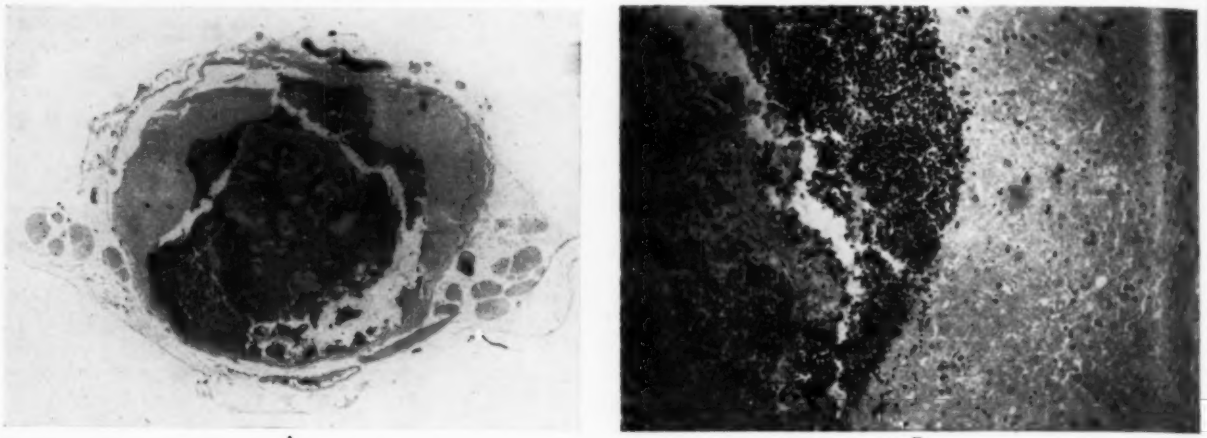
Finally, the rarity of metastatic, intramedullary, spinal tumours in contradistinction to cerebral and cerebellar metastatic tumours is noticeable in our series and has also been mentioned by Lesse and Netsky (1954) and others. This feature, as Willis (1952) remarks, is reminiscent of the remarkable immunity from neoplastic invasion displayed by the peripheral nerves. Even more striking is the rarity of intrathecal and extramedullary metastases, only 1, from a primary adrenal source, having occurred in our series (*Fig.* 452). This patient, a man aged 54, was found subsequently to have an intramedullary tumour also (Rogers and Heard, 1957). Our experience of the rarity of metastatic tumours in the spinal cord agrees with that published by others; thus of 50 cases of malignant spinal neoplasms revealed at autopsy at the Philadelphia General Hospital, involvement of the substance of the cord occurred in only 2 cases (Wilson and Rupp, 1947), and in 1952 Cantor and Stein, in reporting an instance, stated that only 13 verified cases could be found in their review of the literature. A further case has since been reported by Rasch, Rosenbaum, and Heimburger (1953).

An example in our series of dissemination in both brain and cord is the following:—

A commercial traveller, aged 56, had progressive paraplegia over a course of four months after a prostatectomy for benign enlargement of the gland. When seen he had flaccid paraplegia and spinal block at the level of the first lumbar vertebra. Laminectomy revealed a grey tumour, beset with vessels, in the substance of the conus medullaris. A month later he died from bronchopneumonia and at autopsy metastases from a peribronchial carcinoma in the left lung were present in liver, adrenals, kidney, rib, both cerebral hemispheres, right cerebellar hemisphere and the thoracic and lumbar parts of the spinal cord. (*Fig.* 453.)

This infrequency of metastases in the spinal cord as compared with the brain may be due to the relative difference in the masses of the brain and cord. It may also depend on the vascular arrangements, which would appear to favour the passage of

neoplastic emboli to the brain rather than to the cord, the blood-supply to the cord being derived from small, arterial divisions presenting a more tortuous route to tumour emboli than the direct cerebral passage provided by the carotid and vertebral arteries.



A B

FIG. 453.—Metastatic tumour in spinal cord from peri-bronchial carcinoma of left lung. Metastases were present also in cerebrum, cerebellum, liver, adrenals, and other organs. The patient was a man aged 56. A, Naked-eye (slightly enlarged); B, Microscopical appearance. (× 75.)

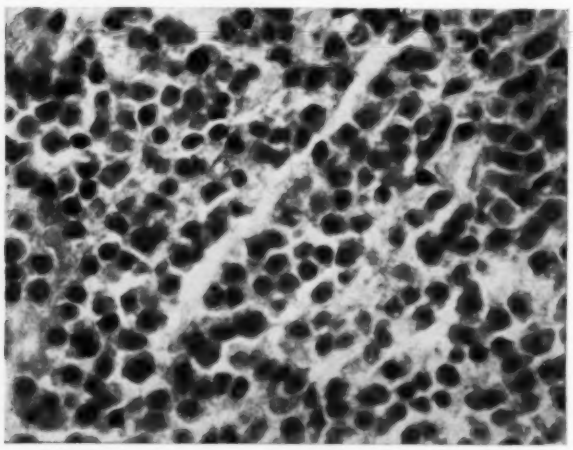


FIG. 454.—Microscopical appearance of a primary, solitary plasmocytoma removed from the epidural space in the thoracic region of a man aged 47 who was paraplegic. Recovery followed, but a year later he had widespread plasmocytosis from which two years later he died. There had been no return of the paraplegia. (× 475.)

Furthermore, the veins of the cord are small when compared with the large vessels of the vertebral venous system and those connecting it with the intracranial sinuses.

A less common route by which the cord may be involved by a malignant tumour is through the subarachnoid space from a primary source in an intracranial tumour.* Medulloblastomata, spongioblastomata, astrocytomata, ependymomata, and oligodendrogliomata have all been recorded as occasionally involving the cord in this way (Cairns and Russell, 1931; Beck and Russell, 1942). Still less common is invasion of the cord by a spread of tumour along the nerve-roots. Such a case has recently been recorded by H. M. Cuneo (1957) in a man aged 30:—

A tumour resembling an inflamed mole arose near the elbow, and over a period of nine years after its removal successive recurrences occurred as subcutaneous nodules.

FIG. 455.—Cutaneous neurofibromatosis appearing twenty-two years after removal of an intrathecal neurofibroma of the second right cervical nerve, which had caused tetraplegia from which he made a complete recovery.

Ultimately forequarter amputation was performed but the tumour spread through the brachial plexus and along the 7th and 8th cervical nerve-roots on the same side to involve the cord and ultimately kill the patient. Metastases were present in the lungs and in one rib. The tumour was regarded as a malignant Schwannoma (neurinoma) and histologically resembled a spindle-celled sarcoma.

* A spread of certain malignant spinal tumours in a reverse direction into the skull by way of the subarachnoid space has been recorded by J. E. A. O'Connell (1946).

Primary Malignant Tumours are either extradural or intradural, the extradural being the commoner.

Extradural Tumours.—The commonest of these is the myeloma or plasmocytoma. When the patient is first seen this tumour is usually solitary, but in the course of time it tends to become part of a generalized disease (Rogers, 1953).

The following is an example of its life history :—

For seven months an express engine driver, aged 47, had backache, at its worst when he was in bed, and girdle pain when walking. His legs and feet began to feel heavy and numb and on examination there was spastic paraplegia with sensory changes. Radiographs showed mild osteo-arthritis of the spine only. There was no Bence-Jones proteose in the urine and myelography revealed spinal block at the upper border of the 9th thoracic vertebra. In January, 1952, laminectomy exposed an extradural fleshy tumour which after removal proved to be a plasmocytoma (*Fig.* 454). He made a rapid recovery and within a fortnight was able to walk normally. He remained well for nearly a year when he became anæmic and urinalysis now showed the presence of Bence-Jones proteose. Although the paraplegia never recurred the disease disseminated and after repeated blood transfusions for recurring attacks of anæmia which was sometimes profound, he died from myelomatosis and pulmonary œdema, some 3 years and 4 months after the first symptom of the disease.

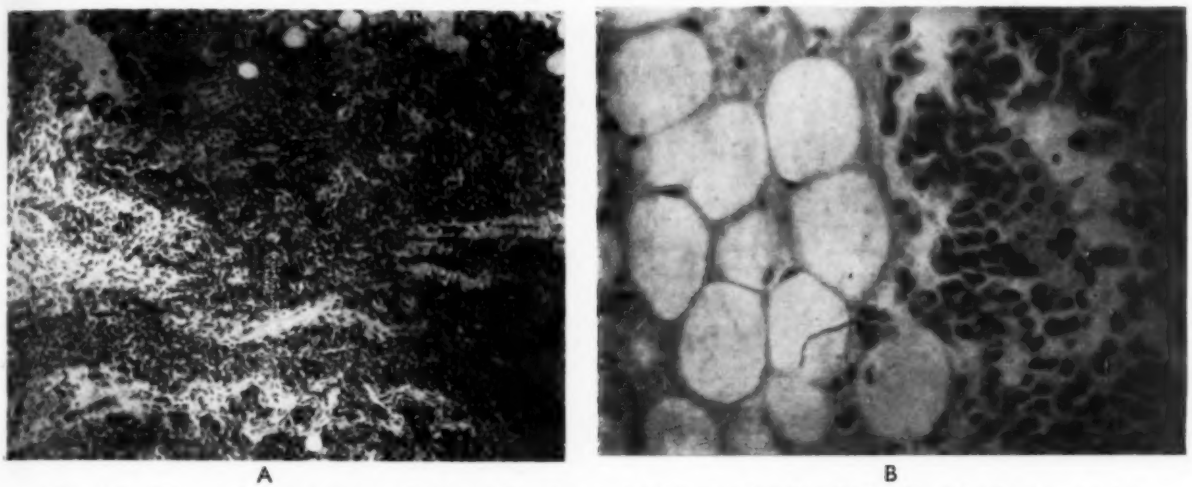
The recovery which followed laminectomy and removal of this tumour made the operation well worth performing, but the case illustrates the tendency of the solitary plasmocytoma to be a forerunner of the generalized disease.

It is interesting to note that very occasionally some essentially benign cord tumours such as the intrathecal and extrathecal neurinomas or neurofibromas may behave in the same way and, like the solitary myeloma, in the course of time and without local recurrence become widely disseminated (Rogers, 1955). The following is an example :—

In August, 1930, a ship's engineer, aged 23, found his right hand becoming weak so that he was unable to grip a hammer firmly. Later he began to limp and soon was unable to walk and became tetraplegic owing to compression of the cord by a large intradural neurofibroma which lay in front of and to the right of the upper end of the cord. After operation he made a complete recovery and has worked hard at sea and ashore for the past 27 years, but during the past 5 years, crops of neurofibromata have appeared on his chest, though there has been no return of paraplegia and he remains well and at work. (*Fig.* 455.)

Patients with primary malignant tumours are usually aged 40 or above, but the youngest in our series was only 10 years old :—

Five weeks before admission to the Cardiff Royal Infirmary, a schoolboy, aged 10, was kicked in the sacral region by a playmate. A fortnight later he complained of intense pain in his back, aggravated by moving his head and legs. Two days before admission he developed flaccid paralysis of his right leg, fleeting sensory changes, and incontinence. Lumbar puncture yielded yellow fluid with a protein content of 2500 mg. per cent and myelography showed a block at the level of the 11th thoracic vertebra opposite a soft swelling to the left of the spinal column. Laminectomy revealed an extradural, soft tumour into which hæmorrhage had occurred. The left sacrospinalis was also invaded by the tumour which proved to be a round-cell sarcoma. He made a good immediate recovery, being relieved of pain and regaining sphincter control and the use of his legs and has subsequently been treated by radiotherapy. (*Fig.* 456.)



A B

FIG. 456.—Microscopical appearances of soft, malignant, round-cell tumour invading fat in the epidural space of a boy aged 10. The tumour had extended into the left sacrospinalis muscle. A, × 75; B, × 300.

Intradural Tumours.—Primary tumours arising within the cord itself are the malignant gliomas, which have been variously classified and are fortunately rare. They include the ependymoblastomas and neuro-epitheliomas, which are highly malignant and are sensitive to irradiation. They are, however, so rapidly destructive of the cord, which itself may be damaged by the irradiation, that such treatment has been found to be of little benefit. As a rule, laminectomy is performed and a biopsy taken before diagnosis is established.

If a limited area only of the cord is involved by a malignant glioma and if paralysis is extensive, the question of radical removal of the tumour by cordectomy should be considered, particularly if the site of the lesion is a caudal one (MacCarty and Kiefer, 1949).

Melanomatosis of the leptomeninges, of which there is an example in the museum of the Royal

College of Surgeons of England, is a rarity which has been recorded by a number of observers and Willis accepts the evidence that some of the reported cases may be primary (Willis, 1952). The condition is only of academic interest.

Most of the patients with primary, malignant tumours of the cord are below 45 years of age.

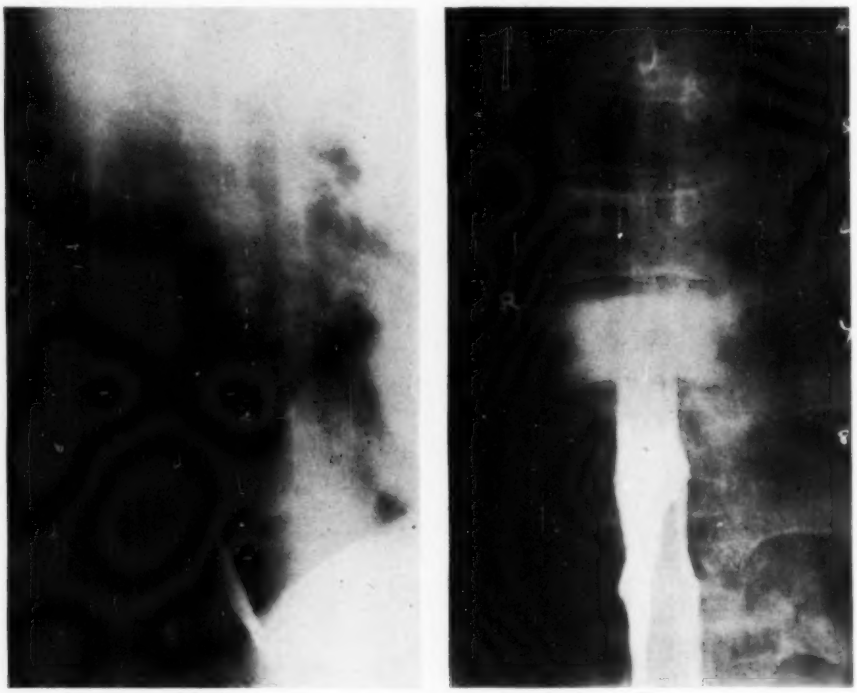
Secondary or Metastatic Tumours.—Secondary or metastatic tumours typically manifest themselves as a progressive paraplegia or tetraplegia, which soon becomes flaccid in type, in a patient who harbours or has a history of having had a malignant tumour elsewhere in the body. The primary source of the tumours in our series which, with the exceptions to which reference has been made, have all been extradural and in the epidural space, has been breast, prostate, bronchus, thyroid, testis, kidney, cæcum, and adrenal. The rarity of intradural, secondary tumours has already been commented upon.

Most of the patients with secondary tumours are over 45 years of age, though cases have been recorded in patients aged 17 and 19 (Bloom, Ellis, and Jennett, 1955).

X-ray films of the spine may show the presence of multiple lesions in bone or reveal a malignant deposit, as the ivory-like vertebra occasionally seen in secondary prostatic cancer, exemplified in the following case :—

A blacksmith, aged 58, related his symptoms of pain and subsequent paraplegia to a fall on his back. The paraplegia progressed and at the time of operation was strongly spastic with a sensory level which related to a densely opaque seventh thoracic vertebral body (*Fig.* 457). The prostate was nodular and hard but the serum-phosphatase levels were normal. At operation a tumour was removed from the epidural space at the level of the dense vertebra and proved to be metastatic adenocarcinoma regarded as prostatic in origin. Seven months later he died from acute bronchopneumonia with tumour emboli and autopsy confirmed carcinoma of the prostate as the source of the spinal lesion.

In 2 of my cases the diagnosis of the lesion was made only at operation ; one patient, a man aged 44, with compression paraplegia was found to have a metastatic thyroid tumour in a lamina of a thoracic vertebra, the primary tumour being a nodule in the left lobe of the thyroid ; the other, a woman aged 56, had a tumour in the epidural space secondary to a small tumour in the right breast. In neither case was the character of the primary tumour such that it had led us to suspect it as the source of a metastatic spinal tumour.



A B

FIG. 457.—Secondary prostatic carcinoma causing densely opaque seventh thoracic vertebra of a man aged 58. The myelogram confirms this as the site of the block.

The relief which follows decompressive laminectomy and removal of a metastatic lesion depends on the nature of the tumour in regard to its degree of malignancy, the general condition of the patient, how early operation to relieve the compression of the cord is performed, and on the efficacy or otherwise of adjuvant treatment such as hormone and X-ray therapy. The following case is illustrative :—

Eight weeks before he came under observation a retired linotype operator, aged 79, had an attack of tenesmus followed by increasing weakness and loss of feeling in the legs with unsteady walking. Twenty-eight years before he had had suprapubic prostatectomy performed and seven years afterwards a vesical calculus removed by my late colleague, T. E. Hammond ; otherwise his life had been healthy and he was remarkably fit for his age and had only recently retired from work. He had spastic paraplegia with an upper sensory level at the eighth thoracic segment. On rectal examination the remnant of the prostatic shell felt hard and nodular.

The serum acid phosphatase was 20·4 units. The cerebrospinal fluid obtained by lumbar puncture contained 80 mg. per cent of protein and myelography showed a block in the upper thoracic region. At laminectomy an extradural tumour which proved to be secondary prostatic carcinoma was removed from the epidural space and the theca relieved from compression. He was given stilbœstrol. He made an excellent recovery, being able to walk again and is well at the age of 81. Re-examination of the prostate removed thirty years ago showed this to be benign. (Rogers, 1957 b.)

Treatment.—Opinion has changed from that expressed by Adson and his associates in 1940 (Rasmussen, Kernohan, and Adson, 1940) that to surgical treatment. In a recent report of 50 cases of spinal extradural tumours treated by laminectomy and post-operative radiotherapy, Mullan and Evans (1957) attributed in large measure the good results obtained in 16 cases to deep irradiation. The least favourable of their cases, which they classified as local, reticular, and metastatic tumours, were the metastatic group.

SUMMARY AND CONCLUSIONS

The spinal epidural space is peculiar and has no intracranial counterpart. Less attention has been given to it than its clinical importance would appear to warrant. It may be the site of either primary or secondary malignant tumours which may involve the cord or its nerve-roots and produce paraplegia and root pain. The commonest tumours of the epidural space are metastatic and would appear to be blood-borne by the vertebral venous system.

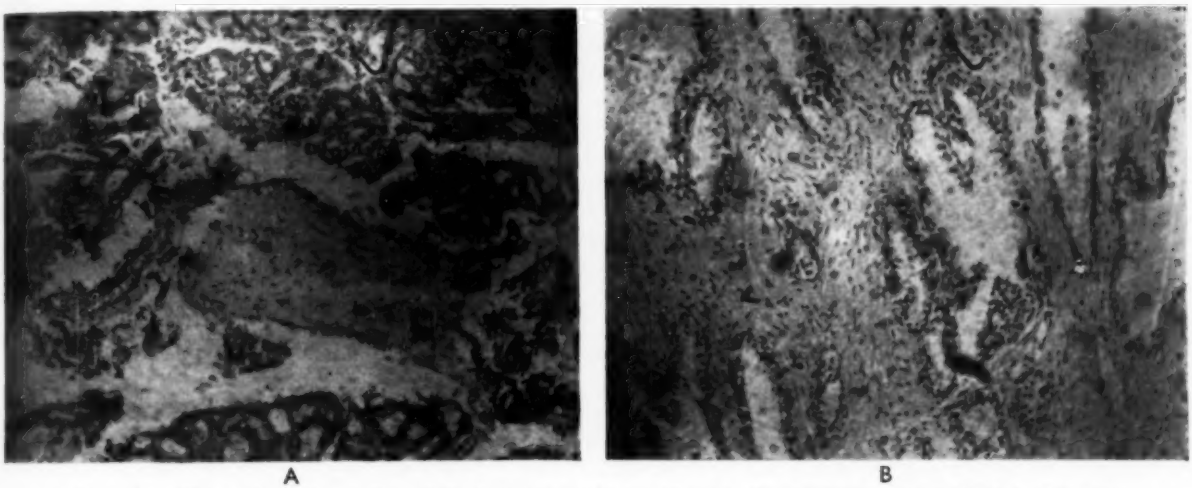
Neoplasms of the epidural space are separable from the dura through a line of cleavage which is absent in the cases of inflammatory masses which cannot be stripped off it.

The dura protects the cord from invasion by malignant neoplasms of the epidural space.

Primary malignant tumours of the cord are rare. Intrathecal metastatic tumours are also rare and, in contradistinction to the brain, the cord is only rarely involved by metastatic tumours. Reasons for this are suggested.

Solitary tumours affecting the cord by compression, such as the plasmocytoma and, more rarely, some neurinomas, may in the course of time disseminate without local recurrence or further involvement of the cord.

Laminectomy should be performed in all cases of progressive compression of the cord, including that caused by malignant tumours. It enables the surgeon to determine the nature of the tumour, to relieve pain and compression, and in some cases results in gratifying improvement of function.



A B

FIG. 458.—Metastatic carcinoma from shell of prostate remaining 28 years after prostatectomy for simple benign hypertrophy. A, Microscopical appearance of epidural spinal metastatic tumour. (× 75.) B, Microscopical appearance of prostate enucleated 28 years before the spinal tumour was removed. (× 75.)

exploratory laminectomy is rarely indicated for metastatic lesions of the spine, to that of C. H. Field and his co-workers in 1956 (Alexander, Davis, and Field, 1956) that with the exception of terminal cases of metastatic cancer, patients who are beginning to develop paraplegia from metastatic lesions should be subjected to decompressive laminectomy.

I believe that unless there is some precise contraindication, laminectomy should be performed in all cases of progressive compression of the spinal cord, including that caused by malignant tumours. Even in cases of suspected metastasis the tumour may prove to be primary and capable of complete removal, but if it should be metastatic, much relief may follow removal of as much of it as possible, pain being alleviated and in some cases some degree of function restored. There can be no reason, except perhaps the advanced condition of an almost moribund patient, to withhold from him or her such relief as an exploratory laminectomy may offer.

Further treatment in the form of hormone therapy in cases of prostatic or breast cancer, adrenalectomy, nitrogen mustard, or radiotherapy may be indicated after the lesion has been disclosed and verified and the cord relieved from compression. Radiotherapy for cord lesions is not without danger, however, as paraplegia may be induced or, if present, increased thereby (Cairns, 1930; Cairns and Fulton, 1930), and expert care is necessary, but with proper precautions radiotherapy may be a valuable adjunct

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THE TENTORIAL NOTCH AND COMPLICATIONS PRODUCED BY HERNIATIONS OF THE BRAIN THROUGH THAT APERTURE

By SYDNEY SUNDERLAND

DEPARTMENT OF ANATOMY AND HISTOLOGY, UNIVERSITY OF MELBOURNE, AUSTRALIA

AN understanding of the manner in which false localizing signs are produced and the significance to be attached to them is of fundamental importance in the diagnosis, localization, and treatment of space-occupying intracranial lesions. The production of such signs by foraminal herniations has long been recognized, and in this category particular importance is attached to displacement of temporal lobe tissue through the tentorial notch. This complication produces a variety of false localizing signs, while its early recognition and correction are matters of extreme urgency because the condition represents a terminal phase in the evolution of supratentorial expanding lesions which, if unchecked, rapidly leads to a fatal termination. It is with herniations of this type that this communication is concerned.

Herniation of the temporal lobe through the tentorial notch, as a distant effect of supratentorial expanding lesions, was first described as a pathological entity by Meyer in 1920. He also attributed an associated hemianopia in one of his cases to compression of the calcarine branch of the posterior cerebral artery by the herniated mass. Since Meyer's observations, a series of investigations has added to the complications that are introduced by dislocations of cerebral tissue occurring through the tentorial notch. Contralateral pyramidal effects follow deformation of the cerebral peduncle on the same side, while displacement of the mid-brain with compression of the opposite crus against the margin of the notch produces ipsilateral signs; the two mechanisms operating together produce bilateral effects which may progress to decerebrate rigidity (Collier, 1904; Groenveld and Schaltenbrand, 1927; Kernohan and Woltman, 1929; Hoen, 1935; Penfield and McEachern, 1938; Jefferson, 1938; Reid, 1940; Riessner and Zülch, 1940; Moore and Bockman, 1941; Schwarz and Rosner, 1941; Evans and Scheinker, 1943; Poppen, Kendrick, and Hicks, 1952; Friedman, 1952; Munro and Sisson, 1952). Disturbances of oculomotor function have been shown to be due to deformation of the oculomotor nerve (Reid and Cone, 1939; Reid, 1940; Sunderland and Bradley, 1953). Vascular complications associated with tentorial herniations vary from pontomesencephalic hæmorrhages (Gehuchten, 1936; Moore and Stern, 1938; Reid, 1940; Schwarz and Rosner, 1941; Evans and Scheinker, 1943; Scheinker, 1945; Cannon, 1951; Poppen and others, 1952; Wolman, 1953; Lindenberg, 1955) to infarctions in the field of the posterior cerebral artery (Meyer, 1920; Moore and Stern, 1938; Penfield and McEachern, 1938; Reid and Cone, 1939; Reid, 1940; Riessner and Zülch, 1940; Allison and Morison, 1941; Schwarz and Rosner, 1941; Evans and Scheinker, 1943; Lindenberg, 1955). Sclerosis of the medial and inferior portions of the temporal lobe, and the associated seizures, have been attributed to temporary herniation of the temporal lobe through the notch at the time of birth with involvement of the blood-supply to this region of the brain (Earle, Baldwin, and Penfield, 1953). Sclerosis in Ammon's horn has also been demonstrated by Meyer (1920) and Lindenberg (1955). Tentorial herniations may also be responsible for disparities in ventricular and lumbar cerebrospinal-fluid pressures in intracranial tumours (Smyth and Henderson, 1938; Reid, 1940), visual field defects (Maltby, 1942; Evans and Scheinker, 1943; Poppen and others, 1952), alterations in the state of consciousness and disturbances in cardiovascular, respiratory, and thermoregulatory mechanisms (Schwarz and Rosner, 1941). The accounts of Vincent, David, and Thiebaut (1936),

David and Askenasy (1937), and Gehuchten (1936, 1937) are concerned with the clinical manifestations of the condition.

With the sole exception of Jefferson's paper (1938), the anatomical features of the region about the tentorial notch have not received the attention that might have been expected in a condition where the anatomical relations of the displaced mass are of prime importance. The object of this paper is to report the results of an examination of the regional anatomy of the notch which emphasize certain additional features associated with herniations through the opening.

THE TENTORIAL NOTCH

The tentorium cerebelli is incomplete centrally and anteriorly where it transmits the mid-brain and associated structures. This opening, the tentorial notch, is outlined by the dorsum sellæ anteriorly and by two curved dural margins laterally. Each margin extends from the dorsum sellæ posterolaterally along the line of the petroclinoid ligament to the apex of the petrous temporal, where it becomes continuous, on each side, with the free edge of the tentorium. These edges sweep backwards, upwards, and medially to meet in the midline at an apex located just beneath, opposite, or above the tip of the splenium of the corpus callosum. From the apex and margins of the notch the dura slopes away posteriorly and laterally as an unbroken sheet to roof the posterior cranial fossa. The aperture widens slightly behind the base before finally narrowing to the apex. Its dimensions vary widely from subject to subject but, in general, the opening can be classed as narrow or broad (*Table I*). An additional feature of interest, to which further reference will be made later, concerns the variable amount of the notch that is occupied by the brain-stem passing through it. In some specimens the dural margins are closely applied to the mid-brain, which is also placed well forwards against the dorsum sellæ; in others a substantial space is left between the mid-brain and the boundaries of the notch.

THE RELATION OF THE TEMPORAL LOBES, BRAIN-STEM, CEREBELLUM, AND CORPUS CALLOSUM TO THE TENTORIAL NOTCH

The Notch viewed from Above after Removal of the Cerebral Hemispheres (*Figs.* 459–464).—Anteriorly the notch is occupied by the mid-brain and pons, and posteriorly by the superior vermis and adjacent lateral lobes of the upper surface of the cerebellum. Variations in the amount of the notch occupied by these structures are shown in *Figs.* 459–464.

Separating the brain-stem from the boundaries of the notch anteriorly is a crescent-shaped interval which will be called the tentorial gap. This interval is the only unoccupied portion of the notch and into it tissue can herniate freely. In this connexion variations in the dimensions of the interval are important. An examination of this feature in 55 subjects has shown that the distance of the dorsum sellæ from the upper border of the pons varied from 2 mm. to 12 mm., with an average measurement of 6 mm. It is not unusual for the distance to be increased in the aged, the findings suggesting a relationship between the distance and the degree of senile cortical atrophy present. The cerebral peduncles and ventral pons carry corticofugal fibre systems, and it might be expected that cortical atrophy would influence the bulk of these structures.

Table I.—DIMENSIONS OF THE TENTORIAL NOTCH

Specimen	Antero-posterior	Width	
		Maximum	Dorsum Sellæ
	mm.	mm.	mm.
1	55	38	35
2	58	31	28
3	57	29	28
4	56	30	29
5	50	31	27
6	53	30	27
7	50	31	29
8	58	33	29
9	47	27	26
10	51	27	23
11	48	29	29
12	53	27	24
13	49	30	27
14	50	30	29
15	55	34	31
16	55	32	30
17	61	37	35
18	52	30	27
19	56	30	26
20	58	27	24
21	52	32	29
22	44	31	30
23	44	28	27
24	53	32	27
25	44	35	34
26	44	31	29
27	45	30	29
28	46	27	25
29	50	32	30
30	50	32	32
31	61	26	25
32	63	30	28
33	64	31	22
34	63	27	23
35	69	39	29
36	57	27	22
37	58	28	26
38	51	24	20
39	66	30	25
40	62	27	23
41	57	28	25
42	55	30	22
43	65	28	23
44	75	34	32
45	64	34	28
46	56	33	26
47	48	29	24
48	53	29	27
49	60	28	27
50	54	23	19

Laterally, the free margin of the tentorium skirts the cerebral peduncle, either in contact with or a variable distance from its anterolateral surface; in the case of the latter the interval is bounded inferiorly by the pons. Further posteriorly, the tectum, which does not extend as far laterally as the peduncles, curves inwards from the edge of the tentorium, which continues backwards and upwards to the apex.

The triangular interval left between the mid-brain and the tentorial margin posteriorly is occupied by cerebellar tissue, which is here closely applied to the tectal surface of the mid-brain so that the latter is well cushioned from the margins and apex of the notch. The extent of the cerebellum visible through the notch posteriorly varies (*Figs.* 459–464). The margins of the notch may meet so close to the mid-brain that no cerebellar tissue is visible in the interval;

broad and long notches, on the contrary, leave a considerable amount of cerebellar tissue exposed from above. Overhanging this region is the splenium of the corpus callosum.

As each margin sweeps upwards and backwards it crosses the cerebral peduncle either in the ponto-peduncular angle or some distance above it. The anterolateral aspect of the peduncle is most closely

FIG. 459.

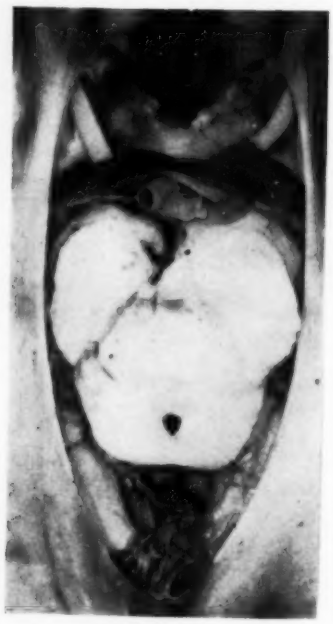


FIG. 460.

FIG. 461.

FIG. 462.

FIG. 463.

FIG. 464.

FIGS. 459–464.—Specimens illustrating variations in the interval separating the boundaries of the tentorial notch from the mid-brain.

The Notch viewed from the Lateral Aspect after Removal of the Hemisphere (*Fig.* 465).—The upper border of the pons may be on the same level as, slightly above, or slightly below the upper margin of the dorsum sellæ. This feature determines the initial relations of the lateral margins of the notch to the brain-stem.

related to the margin and may be in contact with it or some distance from it. Posteriorly the margin inclines more steeply upwards to the apex, crossing the tectal surface of the mid-brain obliquely but separated from it by the cerebellar tissue which occupies the notch. The apex bears a variable relationship to the corpus callosum, the extremes

being points above and below the posterior curve of the splenium.

The optic tract crosses the tentorial margin on its way from the optic chiasma, which is medial to the line of the margin, to the lateral geniculate body which is situated superolateral to it (*Fig.* 466). In those cases in which the dural edge takes a particularly high sweep to terminate above and behind the splenium, it may closely approach the lateral geniculate body.

FIG. 465.—The relationship of the tentorial margin to the mid-brain as seen from the lateral aspect.

FIG. 466.—Dissection illustrating the optic tract crossing above the tentorial margin (dotted line). O.T., Optic tract; P.C.A., Posterior cerebral artery.

The Notch viewed from Below after Removal of the Cerebellum (*Figs.* 467–469).—Such a dissection reveals the relations of the temporal lobes to the notch. The amount of temporal lobe tissue visible depends on the interval separating the margin of the notch from the brain-stem. The region usually concerned is a strip which extends from the uncus backwards along the hippocampal gyrus. Anteriorly, which is always an unoccupied region of the notch, the uncal region commonly prolapses slightly into the tentorial gap, an anteroposteriorly directed linear groove along its undersurface marking the line of the tentorial margin and the extent of the overlap (*Figs.* 467–469). Farther posteriorly this groove is lost, either because the tentorium hugs the brain-stem or because, in the presence of an interval between them, the strip of hippocampal gyrus medial to the margin rests on the upper surface of the cerebellum, the relations of which to the brain-stem and notch in this region have already been described. In some cases, however, hippocampal tissue does prolapse through the notch (*Figs.* 468, 469).

Posteriorly the splenium presents between the brain-stem and apex of the notch, the great cerebral vein of Galen intervening between it and the mid-brain and cerebellum below.

FIG. 467.—The region of the tentorial notch from below to illustrate the relationship of (*a*) the uncus to the tentorial margin and oculomotor nerve, and (*b*) the posterior cerebral artery to the cerebral peduncle, uncus, tentorial margin, and oculomotor nerve.

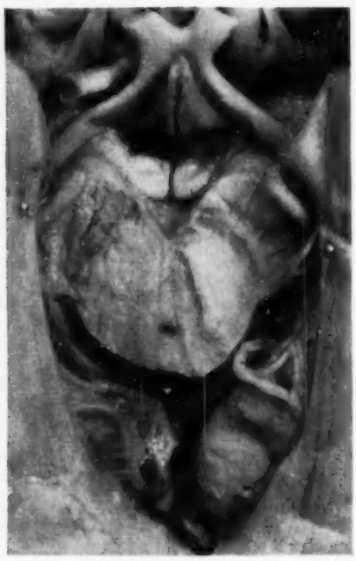
CRANIAL NERVES

Oculomotor Nerve.—The oculomotor nerve emerges from the medial aspect of the cerebral peduncle and continues forwards and outwards to skirt the lateral margin of the posterior clinoid process for a short distance before entering the lateral wall of that structure (*Figs.* 459–464).

Between the brain-stem and the posterior clinoid process the nerve is slung across the tentorial gap, either more or less horizontally, or with an obvious downward or upward inclination, depending on the level of its origin with reference to the upper border of the dorsum sellæ (*Figs.* 470–472).

The oculomotor nerve has certain important relations in the tentorial gap (*Figs.* 459–464, 470–473). At its origin it is placed between the posterior cerebral and superior cerebellar arteries. The posterior communicating and posterior cerebral arteries are

above it; the latter crosses the nerve on its way laterally, while the former is alined superiorly. The superior cerebellar artery runs under the nerve as it proceeds laterally. Consideration of the significance of these vascular relations will be deferred until a later section. A portion of the uncal region of the temporal lobe usually extends inwards over the margin of the tentorium and often becomes closely



FIGS. 468, 469.—Specimens illustrating the extent to which the hippocampal gyrus may normally bulge through the tentorial notch.

A

B

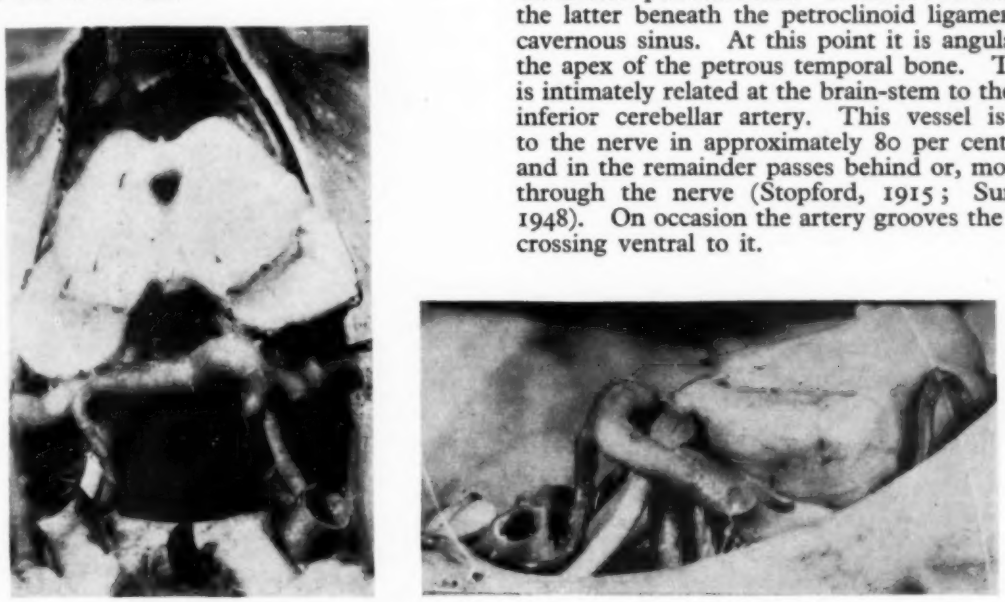
FIG. 470.—Specimen illustrating the vascular relations of the oculomotor nerve at the brain-stem and the high origin of the nerve, which is held elevated by the superior cerebellar artery. A, Ventral aspect; B, Lateral aspect.

related, superolaterally, to the nerve (*Fig.* 467). A further point of interest is that the pupilloconstrictor fibres are concentrated over the superior arc of the nerve from the cavernous sinus to the mid-brain (Sunderland and Hughes, 1946). Thus two vessels, the posterior cerebral and the posterior communicating, and a portion of the temporal lobe are intimately related to that aspect of the nerve in which the pupilloconstrictor fibres are concentrated.

Trochlear Nerve.—After emerging from the dorsal surface of the mid-brain, the trochlear nerve follows the curve of the tectum laterally and then anteriorly until it reaches the free margin of the tentorium where this is skirting the cerebral peduncle. The slope of the tentorial margin brings the trochlear nerve to its undersurface and in this position the nerve continues directly forwards to reach and enter the cavernous sinus. The nerve runs a protected course between its origin and the cavernous sinus, being first interposed between the tectum and cerebellum and then applied to the undersurface of the free margin of the tentorium (*Fig.* 474). The

superior cerebellar artery is below it at the ponto-peduncular angle, where the nerve picks up the free margin of the tentorium.

and slightly outwards from the pontomedullary junction, just lateral to the midline, to the wall of the inferior petrosal sinus. It enters and accompanies the latter beneath the petroclinoid ligament to the cavernous sinus. At this point it is angulated over the apex of the petrous temporal bone. The nerve is intimately related at the brain-stem to the anterior inferior cerebellar artery. This vessel is anterior to the nerve in approximately 80 per cent of cases and in the remainder passes behind or, more rarely, through the nerve (Stopford, 1915; Sunderland, 1948). On occasion the artery grooves the nerve on crossing ventral to it.



A B

FIG. 471.—Specimen illustrating the vascular relations of the oculomotor nerve at the brain-stem and the high origin of the oculomotor nerve. A, Ventral aspect; B, Lateral aspect.

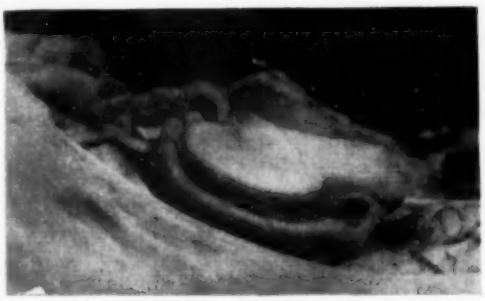


FIG. 472.—Specimen illustrating, from the lateral aspect, a low origin for the oculomotor nerve.

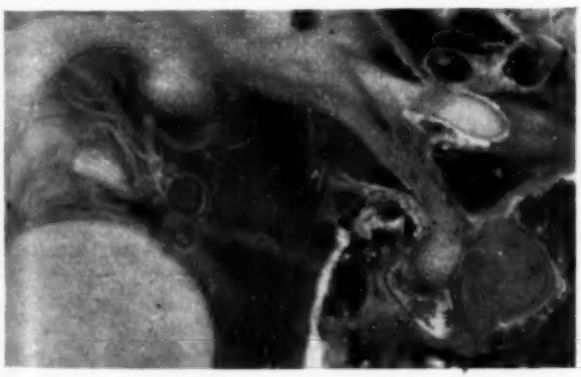


FIG. 473.—Mid-sagittal section illustrating the course of the oculomotor nerve between the mid-brain and the dorsum sellæ.

FIG. 474.—Dissection illustrating the course of the trochlear nerve in relation to the tentorium.

Abducent Nerve.—Though this nerve is not an immediate relation of the tentorial notch, deformation of the brain-stem at this site may have secondary effects on the nerve which impair or block conduction in it. The abducent nerve passes upwards, forwards,

ARTERIES

Posterior Cerebral Artery.—The basilar artery terminates above, at, or below the mid-upper border of the pons by dividing into two posterior cerebral arteries. These curve around the cerebral peduncle

to reach the hippocampal aspect of the temporal lobe, at which point they turn more directly posteriorly. That section of the artery between its origin and the temporal lobe may be defined as the first part and the remainder as the second. Both parts have important relations.

First part: From its origin the artery proceeds laterally in an interval outlined between the cerebral peduncle and that portion of the uncus overhanging the free margin of the tentorium (*Fig.* 467). In this way the artery is directed towards the margin

FIG. 475.—Region of the tentorial notch from below illustrating the posterior cerebral artery proceeding posteriorly medial to the tentorial margin.

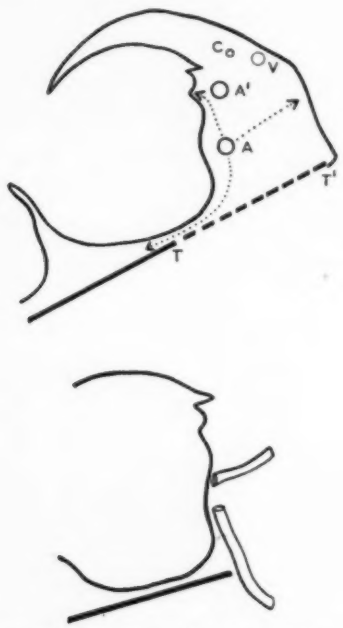


FIG. 477.—Diagrams illustrating the variable relationship of the posterior cerebral artery (A) to the tentorial margin depending on the proximity of the latter to the mid-brain. T and T^1, A and A^1 represent variations in the position of the artery in the interval between the mid-brain and the hippocampal gyrus, depending on the specimen and the level of the section. The dotted lines represent the course taken by branches of the posterior cerebral artery in relation to the tentorial margin. V, Basal vein; C, Anterior choroidal artery.

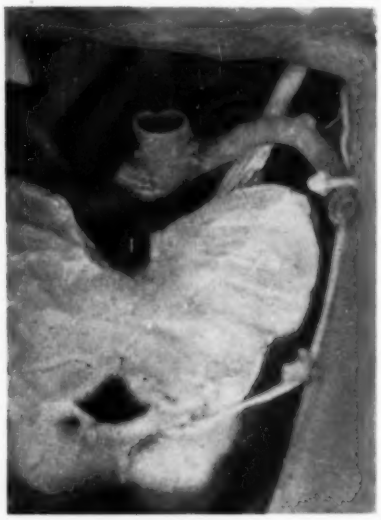


FIG. 476.—Region of the tentorial notch from below, illustrating the posterior cerebral artery crossing the tentorial margin before proceeding posteriorly. The margin only of the tentorium is showing on the left.

of the notch at a point where the temporal lobe is applied to it. The vessel crosses the oculomotor nerve on its way laterally, the intimacy of the relation depending on the respective levels of origin of these two structures. Usually the artery clears the nerve without pressing or pulling on it. When, however, the basilar artery divides at a lower level than usual, and/or the oculomotor nerves leave the mid-brain at a higher level with reference to the posterior clinoid processes, the posterior cerebral arteries ascend more steeply to cross the nerves. Under these circumstances each vessel becomes hooked over the corresponding nerve and pressure produced in this way may be sufficient to groove the upper surface of the nerve (Sunderland, 1948).

This section of the artery is joined by the posterior communicating artery. At and medial to the union the posterior cerebral artery gives clusters of fine branches, some of which supply structures comprising the interpeduncular fossa while others penetrate the posterior perforated substance *en route* to supply the mid-brain, thalamus, subthalamus, posterior hypothalamus, and posterior part of the internal capsule. Beyond the union, the parent trunk gives a long branch or branches, which hug the surface of the mid-brain as they run posteriorly, and it is from this system that fine vessels proceed to supply the choroid plexus, posterior thalamus, lateral geniculate body, and mid-brain laterally and posteriorly.

The terminal bifurcation of the basilar artery is the site of origin of many short fine branches which enter the posterior perforated substance and adjacent structures. This arrangement anchors the posterior cerebral artery at its origin.

Second part: The second part of the artery pursues a supratentorial course which facilitates its terminal distribution to supratentorial structures. Its relationship to the free margin of the tentorium varies, depending on the level of its origin with reference to the tentorial opening and the proximity of the tentorial edge to the mid-brain.

When the artery has an origin above the level of the tentorial opening it proceeds to the hippocampal aspect of the temporal lobe posterior to the uncus and on a plane above the tentorium. Whether or not it crosses the tentorial margin at this site depends on the relationship of the temporal lobe to the tentorial opening. When the hippocampal gyrus extends medial to the margin, as in wide notches, the artery reaches this region without crossing the margin (*Figs.* 475, 477). When, however, the margin is closely applied to the mid-brain the artery crosses it in order to reach the medial aspect of the temporal lobe (*Figs.* 467, 476, 477).

From a low origin the artery ascends in order to reach the temporal lobe, and in doing so must cross, from below upwards, the line of the tentorial margin; whether or not it establishes contact with the dural margin depends on the proximity of the latter to the mid-brain. Furthermore, whether or not it turns laterally over the margin depends on the proximity of the latter to the mid-brain and the relationship of the hippocampal gyrus to the tentorial opening (*Fig.* 477).

Having reached the hippocampal aspect of the temporal lobe the artery proceeds posteriorly, following the sweep of the hippocampal fissure and hippocampal gyrus upwards and backwards. It runs above the tentorial margin, being lateral, directly above, or inside the latter, depending on the relationship of the margin to the mid-brain. Laterally and above are the hippocampal gyrus, dentate gyrus, fimbria, choroid fissure, and tail of the caudate nucleus. Directly above are the pulvinar and lateral geniculate body. Medially is the mid-brain. In the narrow interval between the temporal lobe and mid-brain the posterior cerebral artery is

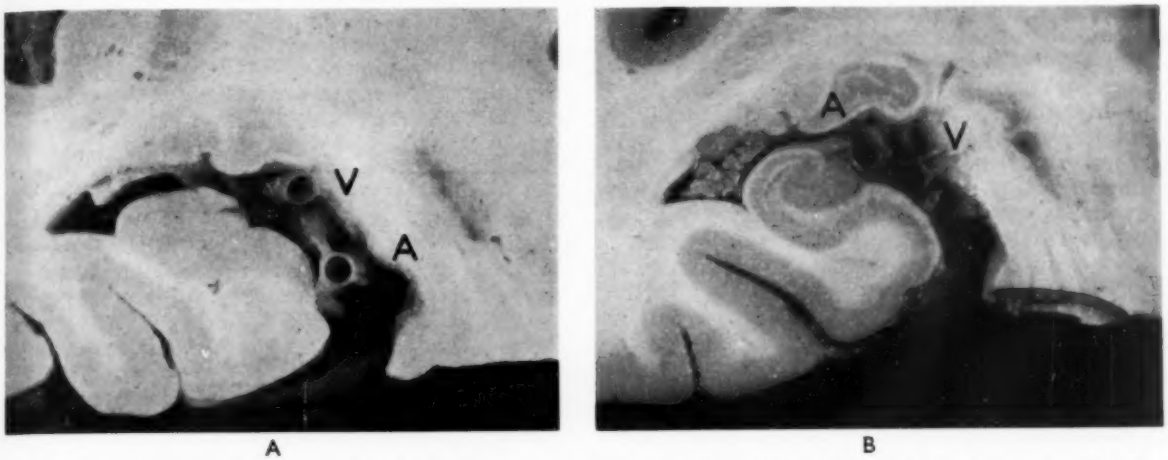


FIG. 478.—Illustrations of two coronal sections of the brain to demonstrate the relative positions of vascular structures in the interval between the mid-brain and hippocampal gyrus. A, Posterior cerebral artery; V, Basal vein.

FIG. 479.—Oblique view from below, after removal of the temporal pole, to show the optic tract (O.T.), anterior choroidal artery (A.C.A.), and posterior cerebral artery (P.C.A.) in the interval between the mid-brain (M) and the hippocampal gyrus (H), and the relationship of the anterior choroidal artery to the optic tract and hippocampal structures.

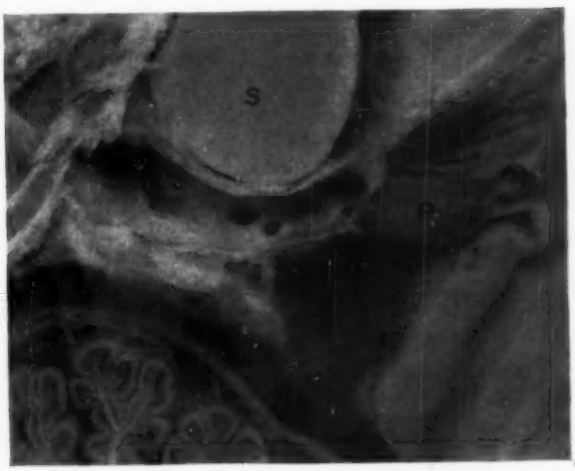


FIG. 480.—Mid-sagittal section illustrating the relations of the great cerebral vein of Galen and the openings of venous tributaries into it. S, Splenium of the corpus callosum; P, Pineal gland.

below the optic tract and the anterior choroidal artery. The latter has followed the tract posteriorly and is here distributing branches to the lateral geniculate body. In this interval also run the basal vein and the branches from the first part of the posterior cerebral artery which are destined for the choroid plexus, thalamus, lateral geniculate body, and mid-brain laterally and posteriorly (*Figs.* 477–479).

Along this section of its course the artery gives branches to (*a*) the entire inferior surface of the hemisphere, except the temporal pole anteriorly; (*b*) the cerebral peduncle, lateral geniculate body, dorsal aspect of the mid-brain and thalamus; and (*c*) the hippocampal structures listed above, perforating branches entering along the line of the hippocampal fissure to supply Ammon's horn. The artery usually gives a long branch which enters the hippocampal fissure and runs along its length, distributing fine branches to this region before finally turning into the choroid fissure posteriorly. Whether or not cortical branches for the tentorial surface of the hemisphere and branches for basal and mesencephalic structures cross the dural margin on their way to their destination again depends on the proximity of the margin to the mid-brain and the relationship of the hippocampal gyrus to the tentorial opening.

Posteriorly the posterior cerebral artery crosses the edge of the tentorium, which is here turning in to the midline at the apex, in order to reach a position between the tentorium and the occipital lobe where the vessel enters the calcarine fissure and divides into terminal branches. These run in the calcarine and parieto-occipital fissures and from here vascularize the medial aspect of the occipital lobe.

Variations in the relationship of the artery to the tentorium influence the effects of tentorial herniation on this vessel and its branches.

Superior Cerebellar Artery.—The superior cerebellar branch leaves the basilar artery immediately below the origin of the posterior cerebral. It follows the slope of the upper border of the pons, below the oculomotor nerve, to the pontopeduncular angle. It then turns posteriorly around the peduncle below the trochlear nerve and the free edge of the tentorium if this is sufficiently close to the peduncle. The vessel proceeds medially in the interval between the tectal surface of the mid-brain and the cerebellum until, just short of the midline, it turns upwards on the anterior face of the cerebellum, finally becoming superficial on that portion of its upper surface which occupies the tentorial opening. The lateral branches on the upper surface pass outwards and backwards under the tentorial margin to be distributed to the upper surface of the cerebellum. Occasionally, in high divisions of the basilar artery, the superior cerebellar branch leaves the parent trunk at a higher level than usual. The oculomotor nerve is then elevated by the artery before falling abruptly anteriorly on its way to the posterior clinoid process (*Figs.* 470, 471).

Posterior Communicating Artery.—This vessel runs anteroposteriorly across the tentorial gap to join the internal carotid and posterior cerebral arteries. It is placed above, and usually medial to, the oculomotor nerve, and medial to the temporal pole. Its branches are for structures in and deep to the peduncular fossa.

The artery sometimes establishes contact with the upper surface of the oculomotor nerve and may press upon it. This is particularly likely to occur when this vessel is enlarged to replace the posterior cerebral artery, which then takes origin from the internal carotid artery. Occasionally such a vessel may groove the upper surface of the nerve (Sunderland, 1948).

Anterior Choroidal Artery.—This vessel arises from the stem of the internal carotid artery lateral and inferior to the commencement of the optic tract. It accompanies the tract posteriorly, crossing its undersurface to occupy a groove between the tract and the cerebral peduncle along which it continues to the lateral geniculate body to which it gives branches. The vessel runs in a narrow space between the optic tract above, the brain-stem medially, and the dentate gyrus, fimbria, and choroid fissure laterally (*Figs.* 477–479). The posterior cerebral artery and free margin of the tentorium are situated inferiorly. Along its course the artery distributes branches to the uncus and amygdaloid nucleus and to approximately the anterior third of the hippocampal and dentate gyri, hippocampus (Ammon's horn), tail of the caudate nucleus, and choroid plexus. Branches directed superiorly and medially supply the optic tract, cerebral peduncle, lateral aspect of the lateral geniculate body, posterior two-thirds of the posterior limb, and the infra- and retro-lenticular parts of the internal capsule, most of the globus pallidus, and the lateral aspect of the ventral nucleus of the thalamus.

Variations in the basal field of distribution of the posterior cerebral and anterior choroidal arteries are common, one system extending to compensate for any reduction in the other. There is also some degree of interchangeability with the field of supply of the posterior communicating artery.

VEINS

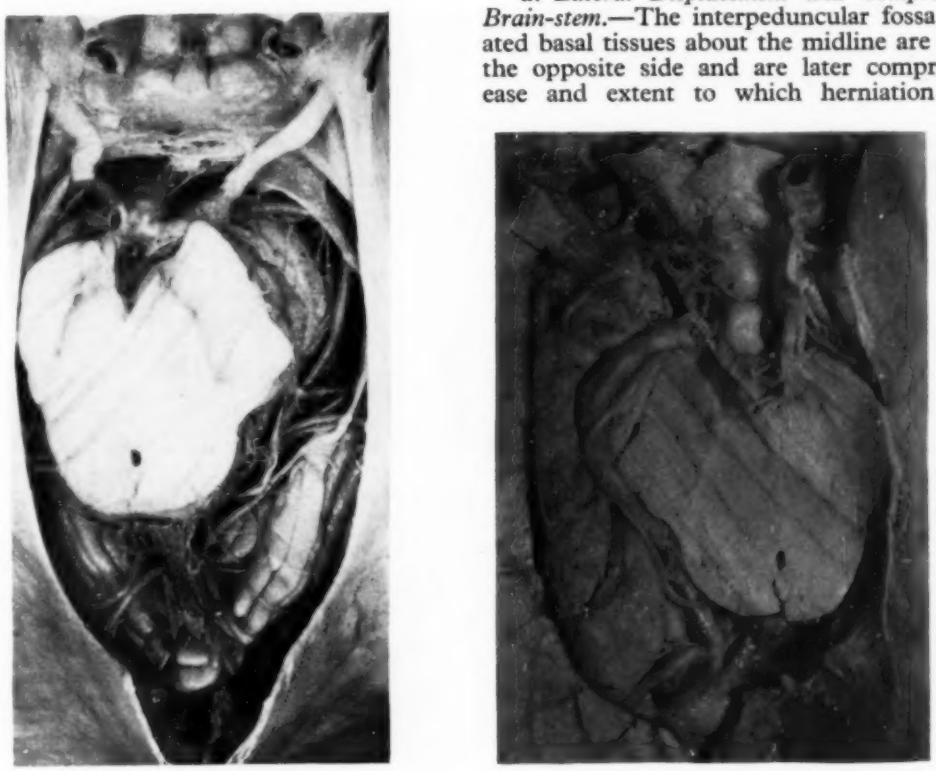
The great cerebral vein of Galen and the basal veins are important relations of the tentorial notch.

Great Cerebral Vein of Galen.—At its origin the great cerebral vein of Galen, formed by the confluence of the internal cerebral veins, has the splenium of the corpus callosum above it while inferiorly are, from before backwards, the pineal body, the colliculi, and that part of the cerebellum which presents through the posterior angle of the tentorial notch (*Fig.* 480). The thin-walled vein turns around the splenium to join, at the apex of the notch, with the inferior sagittal sinus to form the straight sinus. This angulation of the vein around the splenium is accentuated when the apex of the notch is located on the upper surface of the tip of the splenium.

Owing to the elevation of the tentorium in the midline, the straight sinus usually follows the curve of the inferior sagittal sinus and the relationship with the great cerebral vein is one that directs blood from the latter into the sinus system against the direction of flow in that channel. Such an arrangement also obtains where other cerebral veins enter sinuses (Stopford, 1930; O'Connell, 1934).

Basal Veins.—The basal vein commences at the anterior perforated substance and accompanies the optic tract and anterior choroidal artery posteriorly

around the cerebral peduncle, collecting blood *en route* from the field served by the posterior cerebral and anterior choroidal arteries. The basal vein continues beyond the lateral geniculate body to turn in beneath the overhanging splenium. Here it enters the great vein of Galen, though on occasions it proceeds direct to the straight sinus. Tributaries from the neighbouring occipital cortex, brain-stem, and cerebellum also enter the great vein before it curves around the splenium (*Fig.* 480).



A B

FIG. 481.—The region of the tentorial notch (A) and the applied surface of the brain (B) in a case of tentorial herniation illustrating displacement of the brain-stem, deformation of the contralateral cerebral peduncle, stretching of the ipsilateral, and slackening of the contralateral oculomotor nerve. The groove formed where the uncus has been forced onto the oculomotor nerve and the site of involvement of the calcarine continuation of the posterior cerebral artery are indicated by arrows.

CONSEQUENCES OF UNILATERAL SUPRATENTORIAL EXPANDING LESIONS

Supratentorial expanding lesions produce effects about the tentorial notch that follow a characteristic pattern which can be expressed most conveniently in terms of the displacement and deformation of the structures that are arranged about the opening.

The appearance of clinical signs associated with this complication depends not only on the extent to which structures are deformed but also on the rate at which this occurs. The rate of deformation depends on such factors as the rate at which the supratentorial pressure is increasing, and the ease and extent to which temporal-lobe tissue escapes through the opening before enlargement of the herniation occurs at the expense of the mid-brain. Thus signs appear early when structures are deformed rapidly, while advanced distortion may occur before the appearance of signs if the herniation producing it develops sufficiently slowly. The appearance of signs also depends on the precise anatomical relationships about the opening, some arrangements favouring early involvement of structures while others confer a measure of protection which fails only in advanced stages of the condition.

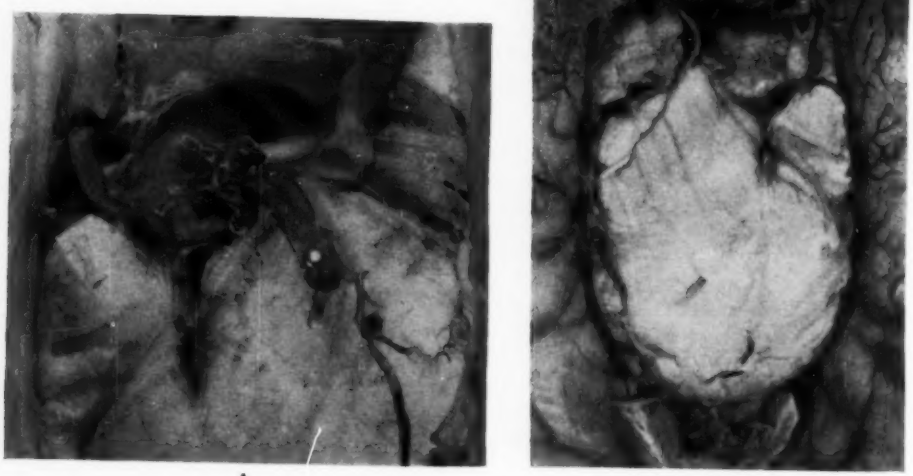
1. THE EFFECT ON THE BRAIN-STEM AND TEMPORAL LOBES

Mechanical Considerations.—

a. Lateral Displacement and Compression of the Brain-stem.—The interpeduncular fossa and associated basal tissues about the midline are displaced to the opposite side and are later compressed. The ease and extent to which herniation will occur through the tentorial opening with a rising supratentorial pressure depends on anatomical variations described earlier. In any event this basal shift carries the brain-stem to the opposite side, which increases the interval between it and the free edge of the tentorium on the same side. This facilitates the herniation of uncal tissue through the aperture on the same side. An extension of this process leads to the involvement of the hippocampal gyrus in the herniation which, as it enlarges, increases and accelerates the influences deforming the brain-stem. The ipsilateral cerebral peduncle is forced still farther medially, is compressed and elongated, while it also comes to assume a more vertical direction than the opposite peduncle, which is forced against the free edge of the tentorium (*Figs.* 481, 482). Finally the hippocampal gyrus, from the splenium to the uncus, is forced through the opening (*Fig.* 481 B) which is now completely plugged with herniated temporal-lobe tissue, deformed caudal hypothalamus, and compressed mid-brain. It is important to note

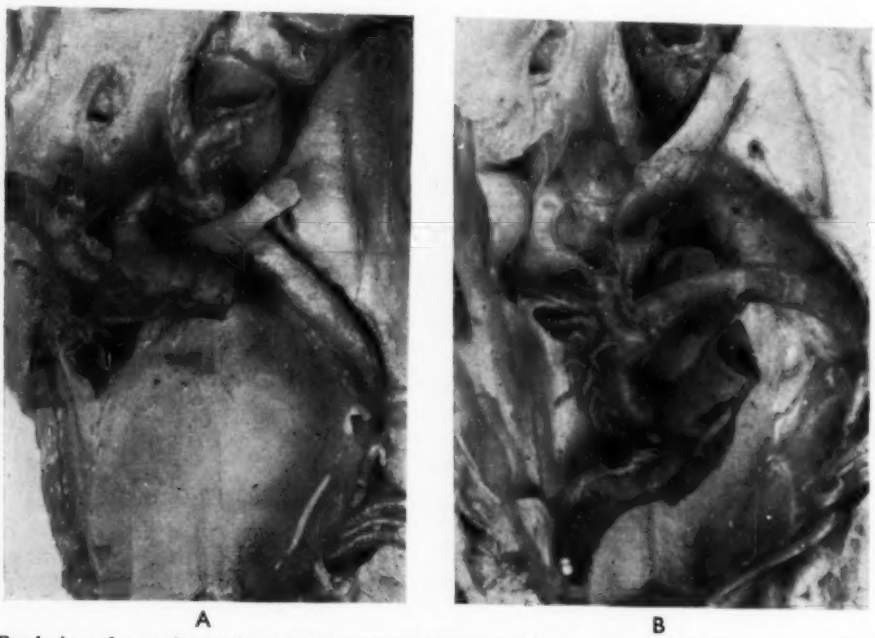
that the amygdaloid nucleus is involved with the uncus in this herniated mass.

The development of a herniation on the opposite side is usually prevented by the early displacement of the brain-stem to that side. However, transference of pressure effects across the midline with the basal shift may initiate a herniation on the contralateral side which is nevertheless limited by the more rapid and progressive development of the ipsilateral herniation.



A B

FIG. 482.—The region of the tentorial notch (A) and the applied surface of the brain (B) in a case of tentorial herniation illustrating deformation of the brain-stem, displacement of the anterior choroidal artery, and deformation of the oculomotor nerve beneath the posterior cerebral artery.



A B

FIG. 483.—Basal view of a specimen of tentorial herniation illustrating the manner in which the posterior cerebral artery has deformed the herniated portion of the temporal lobe and the oculomotor nerve. In B the vessel has been displaced to reveal the deformity.

b. Caudal Displacement of the Brain-stem through the Aperture.—Pressure from above, elongation of the brain-stem under compression, and the movement of herniated cerebral tissue down the side of the brain-stem combine to carry the latter caudally through the aperture. Inferiorly the herniated mass meets the upper border of the pons and tilts it distally on the affected side.

c. Posterior Displacement and Rotation of the Brain-stem.—The development of the tentorial herniation is initiated anterolaterally where the uncal region is driven through the opening. The collection of cerebral tissue under pressure in this particular situation forces the brain-stem posteriorly and may rotate it so that the opposite cerebral peduncle comes to face more directly laterally. As

a result more of its anterior surface is applied to the dural margin of the tentorium against which it is forced and deformed.

Clinical Considerations.—

a. The Level of Consciousness.—The role of mid-brain ascending reticular activating pathways in maintaining a state of awareness is well known (*Brain Mechanisms and Consciousness*, 1954). In this connexion compression of the mid-brain with an associated embarrassment of its blood-supply could be a factor in promoting and maintaining the unconsciousness which appears and deepens as this complication develops.

b. Disturbances of Autonomic Functions.—Lateral and caudal displacement of the caudal hypothalamus with compression of this region and impairment of its blood-supply are reflected in disturbances of cardiovascular, respiratory, and thermoregulatory mechanisms. Vascular and respiratory responses have also been recorded experimentally from stimulation of the temporal pole (Kaada, Pribram, and Epstein, 1949).

c. Disturbances of Motor Function.—Deformation of the ipsilateral peduncle produces a contra-lateral paresis or paralysis, while involvement of the contra-lateral peduncle against the free margin of the tentorium is responsible for the appearance of false localizing ipsilateral effects. In the terminal stages advanced deformation of the mid-brain results in decerebrate rigidity.

d. Altered Cerebrospinal Fluid Dynamics.—Compression of the mid-brain leads to narrowing, and even obliteration, of the aqueduct of Sylvius, while the tentorial opening is plugged with the brain-stem and herniated cerebral tissue. As a result the passage of cerebrospinal fluid down the aqueduct and from the posterior cranial fossa to a supratentorial position is obstructed. This leads to a further increase in the supratentorial pressure. A vicious circle is thereby introduced in which the herniation aggravates those conditions which favour and accelerate its development. This complication is also the basis of the discrepancy in cerebrospinal-fluid pressures recorded from the ventricles and lumbar theca.

e. Changes in Behaviour and Personality.—There is clinical and experimental evidence indicating participation of the amygdaloid nucleus, hippocampal gyrus, and adjacent hippocampal structures in mechanisms underlying patterns of memory, behaviour, and personality (Papez, 1937; Klüver and Bucy, 1939; Spiegel, Miller, and Oppenheimer, 1940; Bard and Mountcastle, 1948; Thomson and Walker, 1951; Klüver, 1952; Gastaut, 1953, 1954 a, b; Falconer, Pond, Meyer, and Woolf, 1953; Schreiner and Kling, 1953; Feindel and Penfield, 1954; MacLean, 1954; Meyer, Falconer, and Beck, 1954; Penfield and Jasper, 1954; Andy and Akert, 1955; Gastaut and Roger, 1955; Meyer, Beck, and Shepherd, 1955; Penfield, 1955; Adey, Merrillees, and Sunderland, 1956; Scoville and Milner, 1957). Deformation of these structures by herniation with restriction of their blood-supply could therefore provide the basis for behaviour and personality disorders contributing to the clinical picture. Residual disturbances of these functions could also be due to permanent scarring caused by trauma and prolonged ischæmia.

f. As the hippocampal region is forced through the tentorial opening and against the brain-stem, the posterior cerebral artery, anterior choroidal artery, basal vein, and optic tract, which are running in the interval between these two structures, are compressed. Visual field changes, consequent on involvement of the optic tract at this site, are usually concealed by deepening coma, but may be recognized if the patient is sufficiently responsive. The changes and signs secondary to involvement of the posterior cerebral and anterior choroidal arteries and basal vein will be referred to later.

2. THE EFFECT ON CRANIAL NERVES

Oculomotor Nerve.—

Anatomical Changes.—The herniated mass is, in the initial stages, forced onto the upper surface of the oculomotor nerve which is running beneath it, while the posterior cerebral artery, which is intervening between the two, deforms both and may subsequently be compressed between them (*Figs.* 481–483). The development of any herniation of the temporal pole on the contralateral side is usually prevented because of the manner in which the herniation on the ipsilateral side occupies the tentorial gap and displaces the brain-stem.

Further complications develop as the supratentorial pressure increases. As a result of displacement of the mid-brain posteriorly and to the opposite side, the ipsilateral third nerve is directed more acutely laterally, is stretched, and is pulled more firmly into contact with the posterior clinoid process. The nerve on the opposite side, on the other hand, comes to run almost directly forwards and is slackened. This feature is illustrated in *Figs.* 481 and 484.

The herniating cerebral mass ultimately reaches and impinges upon the upper surface of the pons on the same side, which is tilted downwards, the descent being facilitated by the elongation of the mid-brain, which follows its lateral compression. Two factors which further embarrass conduction in the third nerve are introduced by this movement. Firstly, each nerve is stretched because the site of origin from the medial aspect of the cerebral peduncle descends. Secondly, the basilar artery, which is tethered to the surface of the pons by numerous, short pontine branches, moves distally with the pons and with it the origin of each posterior cerebral branch. As a result the latter must initially ascend more vertically in order to reach a supratentorial position, and in doing so is pulled across and kinks the *upper* surface of the corresponding oculomotor nerve. The final arrangement in the necropsy material forming the basis of this study was one in which each nerve was hooked below the artery before ascending sharply towards the posterior clinoid process (*Fig.* 485). The compression and angulation of the nerve thus produced was particularly marked on the affected side where the pons and artery were displaced farther distally owing to the tilting of the former. It should be noted, however, that the superior aspect of the contralateral nerve is finally involved as the result of gross displacement. Furthermore, the lateral displacement described above could also be responsible for wedging the contralateral nerve more securely into the angle

outlined by the diverging posterior cerebral and superior cerebellar arteries (*Fig.* 484).

Functional Changes.—The superior portion of the ipsilateral nerve is the first to be affected and, since the pupilloconstrictor fibres are concentrated in this region, early changes in the pupil on the affected side would be expected. Irritation of the subjacent fibres leads to constriction of the pupil, but this

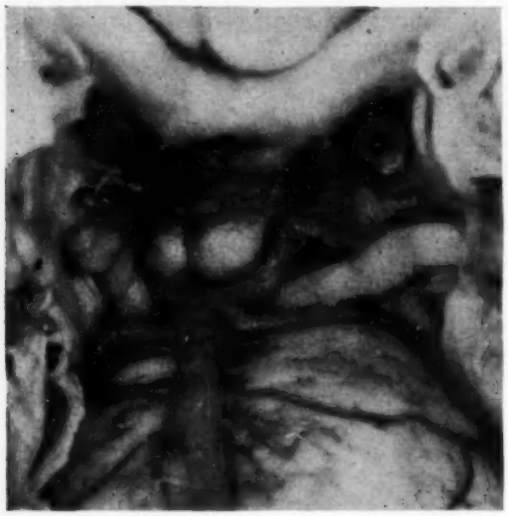


FIG. 484.—Ventral view of the interpeduncular fossa from a case of tentorial herniation illustrating displacement and deformation of the mammillary bodies. The displacement of the mid-brain has slackened the contralateral oculomotor nerve and forced it into the angle of divergence of the posterior cerebral and superior cerebellar arteries. The ipsilateral nerve was directed farther laterally and was stretched before removal, while the herniated mass is shown impingeing on its upper surface.

phase is usually short. With further deformation conduction gradually fails in the pupillary fibres until paralysis is complete and the pupil is fully dilated and no longer reacts. While this is occurring the somatic fibres feel the effects of the compressing force and signs of impaired function appear in the extra-ocular muscles. The appearance of signs on the opposite side indicates that the effects of the hernia are now being felt on that side. Deformation of the upper surface of the nerve by the posterior cerebral artery in the manner described leads to irritation and later paralysis of the subjacent pupilloconstrictor fibres, and therefore to constriction followed by dilatation of the pupil. The somatic fibres in the contralateral nerve escape because the mechanism responsible for deforming the nerve acts, initially, on its upper surface. If, however, the angular pull of the artery persists the somatic fibres are ultimately involved, but before this occurs both pupils will be fully dilated and fixed and the somatic fibres on the ipsilateral side will have failed.

The order of involvement of the fibres comprising the oculomotor nerve is, therefore, as follows: (1) the superior portion of the ipsilateral nerve in which are concentrated the pupilloconstrictor fibres; (2) the remainder of the ipsilateral nerve and hence its somatic motor fibres and/or the superior portion of the contralateral nerve and, therefore, the contralateral pupilloconstrictor fibres; (3) the remainder of the contralateral nerve which represents the somatic component.

Trochlear Nerve.—The trochlear nerve usually escapes in tentorial herniations and the displacements of the brain-stem to which they give rise because of the protected course taken by it between its origin and the site of entry into the cavernous sinus. Occasionally, however, displacement of the brain-stem to the opposite side stretches and exposes the ipsilateral nerve on its way to reach the shelter of the tentorium,

FIG. 485.—Ventral view of the interpeduncular fossa from a case of tentorial herniation illustrating displacement and deformation of the mammillary bodies and the tilting of the pons by the herniated mass, which is also impingeing on the upper surface of the oculomotor nerve. The manner in which the nerve, particularly on the affected side, is hooked acutely under the posterior cerebral artery is also shown.

and in this position it may be reached and pressed on by the herniating mass.

Abducent Nerve.—In 1910 Cushing advanced the view that obscure abducent palsies accompanying expanding intracranial lesions could, in certain cases, be explained on the basis of a strangulation of these nerves by overlying anterior inferior cerebellar arteries. Stopford (1915), however, believed that "when the artery lies in the dorsal position, the abducent nerve may be compressed against the basisphenoid by the vessel, as the former structure proceeds towards the cavernous sinus". Collier (1904) had previously attributed these palsies of the abducent nerves to the displacement "backwards" of the brain-stem from supratentorial pressure which, in the initial stages, produces traction on the nerves, first on the involved side and then on the other. Wolff (1928) claimed that, if this were the factor responsible, the frailer trochlear nerve, with its long anteroposterior course, should be the first nerve affected. However, the direction of the displacement inferred in Collier's description is downwards and not posteriorly as interpreted by Wolff. According to Wolff (1928) the nerve is kinked and constricted at the site of angulation over the apex of the petrous temporal when the brain-stem is driven downwards. In this connexion it should be noted that the first two points of fixation along the course of the nerve are at the pontomedullary junction and where the nerve pierces the dura in relation to the inferior petrosal sinus. Consequently, displacement of the brain-stem downwards would, in the initial

stages, be more likely to stretch the nerve between these two points.

A study of the anatomical arrangement in normal and pathological material confirms that caudal displacement of the brain-stem with secondary tension on the abducent nerves is the causative factor, though the possibility remains that, in certain cases, neurovascular relations may contribute to the disturbance in the manner originally suggested by Cushing.

3. THE EFFECT ON ARTERIES

Posterior Cerebral Artery.—The herniating uncus forces the first part of the artery downwards across the upper surface of the oculomotor nerve (*Fig.* 482). The artery is now looped beneath the herniation, the precise relationships depending on the original slope taken by the vessel on its way across the aperture. The lateral limb of the loop which must, at least in the initial stages, ascend to reach a supratentorial level is, however, forced by the herniation against the free margin of the notch. As more of the hippocampal gyrus is herniated through the opening it carries the second part of the posterior cerebral artery with it, so that the site where the vessel crosses the tentorial margin shifts progressively posteriorly, finally involving only its calcarine continuation (*Fig.* 481). Under these conditions the cortical branches also cross the tentorial margin on their way from the parent trunk in the herniated mass to the undersurface of the temporal lobe.

The hippocampal gyrus not only carries the artery into and through the opening but may swell about it so that the vessel comes to occupy a groove on its undersurface (*Fig.* 483). Thus the artery and its branches are both stretched and compressed by the herniation itself in addition to being compressed against the edge of the tentorium, these factors combining to provide the basis for infarctions and ischæmic changes involving hippocampal structures and the occipital and temporal lobes. A further factor embarrassing flow in the artery is the kinking, described in an earlier section, which occurs where the vessel crosses the oculomotor nerve; the nerve, however, is not the rigid structure described by others (Evans and Scheinker, 1943). The point where the artery is compressed against the free edge of the tentorium will vary from case to case, but in well-advanced herniations it is the calcarine continuation that suffers most. This explains why associated cortical vascular complications occur most commonly on the medial aspect of the occipital lobe (Moore and Stern, 1938).

Some anatomical arrangements favour involvement of the opposite posterior cerebral artery, which is caught against the edge of the tentorium by the displaced mid-brain. This accounts for vascular complications affecting the occipital lobe on the opposite side.

Superior Cerebellar Artery.—This vessel is protected from herniations entering the aperture from above and the distortion of the brain-stem produced by them. In extreme cases the artery may be compressed where it is turning posteriorly in the pontopeduncular angle.

Posterior Communicating Artery.—This vessel is displaced medially in the interpeduncular fossa and may be compressed in large herniations.

Anterior Choroidal Artery.—This vessel is compressed between the herniated hippocampal mass laterally and the cerebral peduncle medially. The compression may lead to ischæmia or infarction in the field of supply of the vessel, namely the amygdaloid nucleus, uncus, hippocampal formation, optic tract, lateral geniculate body, posterior limb of the internal capsule carrying the optic radiation, part of the globus pallidus, and cerebral peduncle. Collateral circulations with the posterior cerebral artery in these cases are inadequate if this vessel is also affected.

Changes consequent on the Impairment of the Circulation in Regions supplied by the Affected Arteries.—

a. Visual field defects could be due to :—

i. Involvement of the posterior cerebral artery, or its calcarine branch, affecting the striate cortex and/or the lateral geniculate body.

ii. Involvement of the anterior choroidal artery affecting the optic tract, lateral geniculate body, and/or the optic radiation in the internal capsule.

iii. Compression deformation of the optic tract itself.

b. Contralateral hemiplegia due to involvement of the blood-supply to the cerebral peduncle from the posterior cerebral and anterior choroidal arteries. Reference has already been made to direct involvement of the peduncle by the herniated mass.

c. Residual disorders of personality and behaviour due to ischæmic changes in the amygdaloid nucleus and hippocampal structures consequent on involvement of the anterior choroidal and posterior cerebral arteries.

d. Compression ischæmia of the mid-brain contributing to unconsciousness and decerebrate rigidity.

e. Contralateral disturbances of sensation due to involvement of the blood-supply to the ventral thalamic nucleus.

The recognition of visual field defects and sensory disturbances is impossible in those patients who are so critically ill that they are unable to co-operate in the examination. Residual defects persisting after recovery are due to sclerosis following ischæmia.

f. Hæmorrhage into the brain-stem, concerning the origin of which (arterial, Moore and Stern, 1938; or venous, Scheinker, 1945; Cannon, 1951) there is some disagreement, is usually regarded as a terminal event which contributes to the clinical picture of failing mid-brain function. However, surviving cases could very well harbour residual pathology but may recover without sequelæ (Poppen and others, 1952).

4. THE EFFECT ON VEINS

The Basal Vein.—This vein is compressed where it is running in the groove between the mid-brain and herniated temporal lobe. Venous congestion is probably corrected by collateral circulations operating distal to the site of compression, though it is conceivable that impaired venous return from the deep field drained by this vein might lead to further brain swelling.

Great Cerebral Vein of Galen.—This vein usually escapes during the early development of supratentorial herniations and the displacement of

the brain-stem produced by them. The vein may ultimately, however, be carried from the midline with the displaced basal structures which are moving to the opposite side under the falx. As a result the vessel becomes kinked at the site of its entry into the straight sinus. The effects of Galenic block on cerebrospinal-fluid dynamics and cerebral œdema are well known.

According to Stopford (1928) another mechanism is responsible for involvement of the vein. He postulated that supratentorial tumours, particularly those located posteriorly, deflect the falx cerebri to the opposite side, thereby elevating the tentorium along the line of its attachment to the falx and with it the apex of the tentorial notch. This aggravates the curvature of the great vein of Galen around the splenium and results in its obstruction. Whether or not such resistant structures as the falx and tentorium would yield sufficiently in the manner described is questionable.

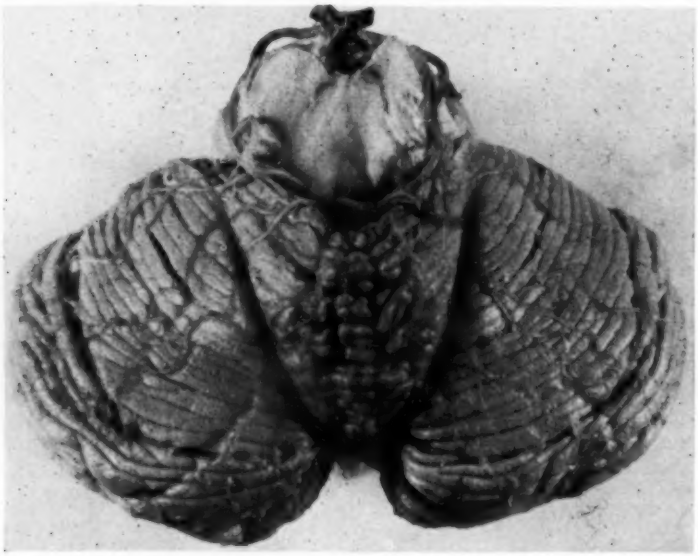


FIG. 486.—Specimen illustrating herniation of cerebellar tissue through the tentorial notch. Branches of the superior cerebellar arteries were compressed at the point where they crossed under the tentorial margin.

CONSEQUENCES OF BILATERAL OR GENERALIZED SUPRATENTORIAL CONDITIONS THAT RESULT IN RAISED SUPRATENTORIAL PRESSURES

Under these conditions there is no initial lateral displacement of the brain-stem to open up the tentorial interval on one side or other. The herniations, which develop bilaterally, involve the uncus or even longer sections of the hippocampal strip behind the uncus in those cases in which there is an interval between the cerebral peduncle and the free margin of the tentorium. They may be sufficiently severe to cause bilateral sclerosis in the herniated tissues.

CONSEQUENCES OF SUBTENTORIAL EXPANDING LESIONS

Lesions in this category lead to herniations of cerebellar tissue through the foramen magnum below and the posterior angle of the tentorial notch above (*Fig.* 486) (Spiller, 1911; Reissner and Zülch, 1940; Ecker, 1948; Jefferson, 1951). Only the latter variety concerns us here. The herniated tissue threatens two structures, the great vein of Galen and the superior cerebellar arteries, and forces the mid-brain forwards and later compresses it dorsally.

Great Cerebral Vein of Galen.—This vein is interposed between the cerebellum and the splenium of the corpus callosum, the latter having the unyielding lower margin of the falx cerebri above it.

Stopford (1928) attributed the raised intracranial pressure in expanding posterior cranial fossa lesions to elevation of the tentorium and with it the apex of the notch which marks the termination of the great cerebral vein. He described and illustrated the vein curving around the splenium to enter the straight sinus, and pointed out that elevation of the apex would result in tension on the vein around the splenium, with obliteration of its lumen.

Whether or not the tentorium and its apex can be elevated sufficiently in this way is doubtful, though Ecker (1948) has demonstrated elevation of the straight sinus in a venogram. Another mechanism producing Galenic block could operate in these cases. The cerebellar tissue herniated through the posterior angle of the notch is immediately below the great cerebral vein and forces it upwards against the splenium which has above it the unyielding lower margin of the falx. In this way the vein is compressed between the herniated cerebellar mass below and the splenium above, and, importantly, the segment involved is that which receives the basal veins and venous tributaries from neighbouring structures. The effect of Galenic block at this site on the intracranial pressure is well known.

Compression of the vein between the splenium above and herniated cerebellar tissue below operates regardless of the manner in which the vessel terminates in relation to the curve of the splenium. On the other hand, the explanation advanced by Stopford would apply only when the vein is angulated around

the splenium to enter the straight sinus, and this is not a constant arrangement at its termination.

Superior Cerebellar Arteries.—The parent channels escape, but the branches passing laterally under the free margin of the tentorium to ramify over the superior surface of the lateral lobes are compressed where they pass under the margin of the notch. Usually the collateral circulation established with other cerebellar vessels is adequate to maintain the arterial supply, but on occasion kinking of a branch may lead to an ischæmic necrosis in the field served by it.

GENERAL COMMENT

Some conditions responsible for tentorial herniation are fully reversible and as they subside the herniation reduces spontaneously. The non-reversible variety on the other hand requires craniotomy for the elimination of those factors which are responsible for the development of this dangerous complication. This procedure, however, may fail to relieve an impacted herniation which can only be effectively reduced by measures directed at the site of impaction (Vincent and others, 1936; Riessner and Zülch, 1940; Guiot and Janny, 1947; Munro and Sisson, 1952; Friedman, 1952).

Structures included in the herniation or in the field of affected vessels may suffer permanent injury, and of particular importance in this connexion is the ischæmic sclerosis involving hippocampal structures which may provide the background for psychomotor epilepsy of temporal lobe origin.

It is also noteworthy that the arrangement of structures at and in the vicinity of the tentorial notch favours the laceration of the mid-brain, uncus, and hippocampal region against the margin of the tentorium when violent displacement of the base of the brain is produced by severe head injury.

SUMMARY

Attention is directed to anatomical arrangements at and about the tentorial notch which favour (*a*) the development of herniations through that aperture with expanding lesions developing below ar], particularly, above the tentorium; and (*b*) the deformation of structures as a result of the herniation.

Supratentorial herniations produce a variety of false localizing signs which are of great importance in the recognition of this complication and which demand urgent attention.

Pyramidal effects, decerebrate rigidity, signs of oculomotor involvement, visual field defects, behaviour and personality defects, deepening coma, and secondary factors contributing to the rising supratentorial pressure can all be traced to the displacement and mechanical deformation of structures arranged about the notch or to interference with their blood-supply.

The mechanisms operating to produce these effects have been detailed.

Reduction of the herniation either spontaneously or by craniotomy may or may not be followed by sequelæ depending on the occurrence, distribution, and severity of a residual sclerosis in structures involved in and by the herniation.

The author is indebted to Mr. R. Hughes for the photographs accompanying this paper.

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CONGENITAL DISLOCATION OF THE HIP

ITS EARLY RECOGNITION AND TREATMENT

BY SIR HARRY PLATT, BT.

CONSULTANT ADVISER IN ORTHOPÆDIC SURGERY, MINISTRY OF HEALTH; EMERITUS PROFESSOR OF ORTHOPÆDIC SURGERY, UNIVERSITY OF MANCHESTER; IMMEDIATE PAST PRESIDENT, ROYAL COLLEGE OF SURGEONS OF ENGLAND

MY own experience in the treatment of congenital hip dislocations over a period of forty-three years has now embraced 743 dislocations in 587 patients (unilateral 431; bilateral 156). But the numbers diagnosed and treated before the child had begun to walk have been small—35 patients with 36 dislocations. This is in striking contrast with the figures for (1) *manipulative* (closed) *reductions*, 373 patients (454 hip-joints); and (2) *open reductions*, 126 patients (146 hip-joints).

In many countries, of which Great Britain is one, this deformity is uncommon and is likely to remain so unless new genes are introduced into their populations. It is therefore not surprising that the first impetus towards the recognition and treatment of dislocations in the young infant came from Northern Italy, where the high incidence of the deformity has come to be regarded as a serious social problem. It has been estimated that in Italy out of one million live births each year, four thousand infants have congenital hip dislocations (Scaglietti, 1939).

In 1927 that great European orthopædic surgeon, Vittorio Putti, Director of the Rizzoli Institute at Bologna, published the first account of the characteristic physical signs of the dislocation in the young infant and described the simple method of achieving gradual reduction by the use of the divaricator splint. Two years later Putti presented his further observations at a meeting of the British Orthopædic Association in London, and emphasized the need for the wide dissemination of this knowledge amongst family doctors, midwives, nurses—even amongst the general population, and more particularly those mothers who themselves had been treated for the deformity in childhood. In 1932 Putti reported on the results of the divaricator treatment of 119 infants (unilateral 67, bilateral 52, females 84, males 35)—all treated as out-patients. In 113 of these children the reduced hip-joints were categorized as perfect anatomical and functional results. Only 6 cases were failures, 3 dislocations being reduced by manipulation under anæsthesia later, and 3 were primitive luxations found to be irreducible.

Twenty-five years ago it seemed that a new era had opened in the treatment of congenital dislocation of the hip. Thus from Czecho-Slovakia, where the incidence of the deformity is also high, Hilgenreiner, of Prague, reporting in 1935 on a series of 157 cases treated under the age of one year by gradual reduction on a metal splint, stated that from 1930 onwards 74 per cent of all cases of congenital hip dislocations dealt with in his clinic were diagnosed under one year and treated without delay.

EARLY DIAGNOSIS

Let us turn for a moment to the clinical picture of the dislocation in the young infant. Since the epoch-making paper of Putti, the physical signs suggesting the presence of a congenital hip dislocation in a young infant have become familiar to all orthopædic surgeons—and in modern times to the pædiatricians. In a *unilateral dislocation* these are: (1) the shortened limb; the tendency to eversion; and the limited abduction—a group of signs often first noted by the mother—and (2) asymmetry of the skin creases; deepening of the inguinal sulcus; telescoping; and a click when the hip is fully abducted (Ortolani, 1948)—signs to be looked for by the experienced clinician (*Fig.* 487). In *bilateral dislocations*—the lateral bulge of the trochanteric regions and the limited abduction in both hips are significant features.

The final proof of the existence of an abnormal hip-joint comes from the radiographs. In unilateral luxations, when compared with the normal side—if that hip shows no blemish—the sloping socket roof, the disturbance of Shenton's line, and the lateral displacement of the femoral head with its delayed

ossific nucleus are anomalies which can hardly escape notice (*Fig.* 488). In bilateral luxations with minimal displacement, the picture may not be so striking, and particularly when the luxations are symmetrical. The use of arthrography by contrast media in young infants has found few adherents, but it has been demonstrated recently by Schorr and Makin (1955) that ' push and pull ' radiographs give all the advantages of arthrography without the need for intra-articular injection.

FIG. 487.—I. L., 9-months-old baby. Congenital dislocation of hip (L.). Shows shortening, asymmetry of skin creases, and limited abduction on affected side.

SPONTANEOUS REDUCTION

Before the advent of the era of the more frequent diagnosis and treatment of congenital hip luxations in young infants, the possibility of the occurrence of spontaneous reduction had been considered by a number of writers. From 1921 onwards a number of undoubted examples of spontaneous cure have been recorded (Kopits, 1921; Ducroquet, 1924; Slomann, 1924; Steinfeld, 1926; and others). My experience of this phenomenon is limited to two authentic cases only, one of them under the care of a colleague. This was a female infant whose elder sister had been treated for a congenital hip dislocation. The infant's hips were deliberately radiographed three days after birth and at that time were regarded as normal. The child was next seen fourteen months later, when it was clear that the left hip was dislocated. A scrutiny of the earlier films (in the three-day-old infant) showed an unmistakable *bilateral* symmetrical subluxation with the femoral heads standing away from the pelvis and Shenton's line disturbed. In the radiographs fourteen months later the left hip was now completely dislocated but the right hip showed the femoral head in the socket, although not fully contained and with a slight disturbance of Shenton's line; i.e., this hip had become reduced, but was not a perfect fit.

The second case, an infant of nine months presenting slight asymmetry of the lower limbs, showed in the radiographs the anatomical defect of a congenital subluxation of the left hip. Admission to hospital was for domestic reasons delayed for eight months. On arrival the hips were radiographed again and the *left hip* now showed a state of concentric reduction (*Figs.* 489, 490).

The occasional occurrence of spontaneous reduction in a congenital luxation does not justify a waiting policy once the diagnosis has been established in the young infant. We must regard such happenings as evidence that in the majority of such cases reduction is likely to be easily achieved by the simple and gentle methods now available.

FIG. 488.—S. B., 5-months-old baby (female). Congenital dislocation of hip (L.). Note sloping socket, disturbance of Shenton's line.

RESULTS OF TREATMENT IN INFANTS

In the technique of gradual reduction the original divaricator splint of Putti or one of its modifications has stood the test of time. Where the infant is

treated as an out-patient the mother has to be taught how to maintain the hip continuously in abduction. Perhaps the simplest out-patient apparatus for this purpose is the abduction pillow-splint introduced by Frejka, which is an admirable method of retention

FIG. 489.—B. T., 9-months-old baby (female). Congenital subluxation of hip (L.). Radiograph, left hip, showing sloping socket and disturbance of Shenton's line.

once the hip has reached the position of 90 degrees abduction and the reduction is stable. In my own divaricator series, for social and domestic reasons, all the infants have been admitted to hospital, and the success of the method has depended on the skill and resource of the nursing staff. In my opinion the policy of treating these babies in hospital has been well worth while.

PERSONAL SERIES

The number of infants treated before the walking stage in my own series is 35 patients (36 hips). Some of the children whose attempts at walking were delayed were over one year old when treatment was begun. Furthermore, the divaricator method of gradual reduction has been used successfully in a number of young children in the second year of life who had already walked or had attempted to walk. Thus, the divaricator method has been used in 45 cases, but there have been 12 failures.

In the 35 infants treated before the age of walking (maximum age 1 year and 7 months) the methods of treatment used were as follows :—

Divaricator alone	25	
Divaricator failure followed by manipulative reduction	5	7
Divaricator failure → manipulative reduction → open reduction	2	
Primary manipulative reduction	3 (1 failure).	

In the first group (*divaricator alone*, 25 cases), 8 are five-year results and over, and 8 ten-year results and over, the longest follow-up period being twenty-three years (*Fig.* 491). All these 16 children have hip-joints showing perfect function with no structural blemish. It is to be noted that 1 child in this series was later found to present a mild degree of spastic palsy, and 2 children had associated congenital deformities (talipes and congenital scoliosis). The more recently treated cases show signs of equal promise. The quality of such *anatomical* results must be contemplated with deep satisfaction.

In the 7 *failures* to obtain reduction by the divaricator the cases are not a homogeneous group.

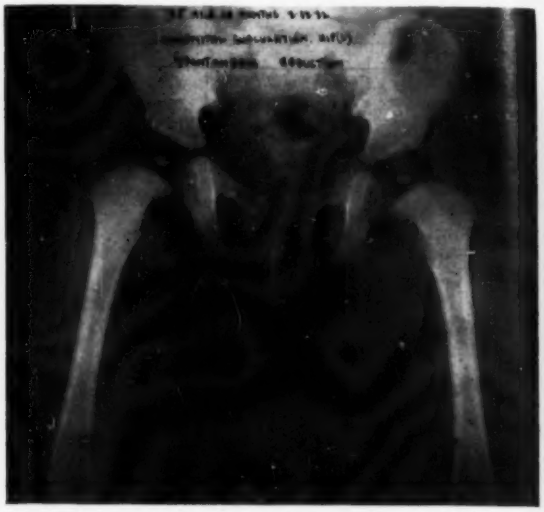

FIG. 490.—Same case now aged 18 months. Left hip, concentric reduction.

FIG. 491.—S. B. Congenital dislocation hip (L.). Treated on divaricator at age of 5 months. Result 23 years later. Pre-reduction radiograph in *Fig.* 488.

Two were ' queer ' hips—one of them diagnosed and treated at the age of one month was found to be completely irreducible both by divaricator and manipulation, but was later reduced by the open method. In another recent case a residual subluxation followed manipulative reduction, and an open reduction with a shelf has so far produced an excellent functional result, but with a hip showing a slight blemish. Another manipulative reduction following a divaricator failure—now a four-year result—is equally good so far, but in the 2 longer term ' follow-ups ' (seven and thirteen years respectively) the hip-joints though perfect in a functional sense show definite anatomical imperfections.

Of the 3 dislocations in young infants treated primarily by *manipulative reduction*, 1 was a queer

hip which redislocated. Further treatment was impossible as the child could not be traced after leaving hospital. The remaining 2 cases, both examined seventeen years since the time of reduction (reduced at eight months and thirteen months), had perfect hip-joints.

Twelve divaricator failures in 45 cases treated by this method (including those children treated after

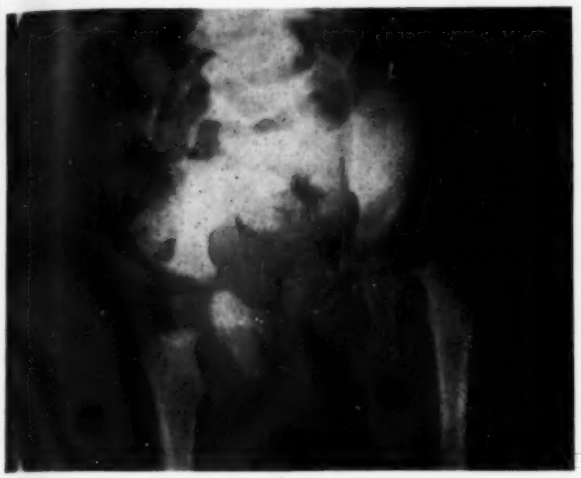

FIG. 492.—D. C., 6-months-old baby (female). Mother treated for congenital hip dislocation in childhood. Left hip shows congenital dislocation.

FIG. 493.—Same case two years after treatment on divaricator. Concentric reduction.

FIG. 494.—J. B., 4-months-old baby (female). Mother with bilateral congenital subluxation of hip-joints. (Italian.)

weight-bearing had begun) is a chastening experience. It serves to remind us of the fact, often overlooked, that in congenital hip luxations we are dealing with a number of different morphological types, and that the inherent structural defects in some of these hips may not only offer formidable obstacles to easy reduction but may represent a state of irreducibility even in the first few months of life.

DIFFICULTIES IN EARLY DIAGNOSIS

Although from 1930 onwards orthopædic surgeons throughout the world have been on the alert for the recognition of the deformity in infants (we may regard the six years of the second World War as a fallow period), it is somewhat surprising to find that in the great mass of literature on the subject of congenital dislocation of the hip since 1945 attention

FIG. 495.—Same case four years after treatment on divaricator—symmetrical hip-joints.

has been mainly concentrated on: (1) the analysis of manipulative reduction in children under 5 years, and (2) the role of open reduction in young children. Thus, in Brittany, where like Northern Italy the deformity is endemic, a special diagnostic and treatment centre was opened in 1946 by the late Professor Jacques Leveuf, of Paris. In this centre hip arthrograms have been done on the newly born, not only for diagnostic purposes, but with the idea of determining at the earliest stage which dislocations would need open reduction! At that time Leveuf was the leading exponent of early open reduction in the

true dislocations which he distinguished from the subluxations. In 1955 Bertrand, the disciple and successor of Leveuf, reviewed the results of 394 open reductions carried out in children under five over a period of nine years—90 per cent of these results were classified as satisfactory.

All this suggests that, despite our awareness of the importance of early diagnosis, the great majority of hip dislocations continue to escape recognition in the pre-walking stage. This is certainly true in my own practice. I treated my first infant dislocation in 1928 in a baby girl of 9 months by manipulative reduction—a queer hip which redislocated. It was two years before another infant dislocation was picked up—again a queer hip in a baby boy of 6 months which did not reduce on a divaricator, but was successfully reduced by manipulation under anæsthesia. The period 1930–1957 produced 34 cases—7 cases before the War; 3 cases during the War years (1939–1945); and 24 cases in the period after the War. These 34 infants represent a very small minority of my series of congenital hip dislocations diagnosed and treated during this same twenty-seven year period—413 children with 519 dislocations, i.e., *less than* 10 *per cent*.

And yet at first sight when we contemplate the characteristic physical signs of hip luxations in the infant, the problem of early diagnosis would seem to be a relatively simple affair. But are these physical signs, or some of them at least, always significant? The answer is 'No'. It has been my experience, and no doubt that of others, on a number of occasions to see an infant with definite shortening of one lower limb and asymmetry of the skin creases in whom no luxation of the hip-joint could be found to exist either then or later. It has also become evident that asymmetrical signs conspicuous enough to persuade the mother to bring the infant for inspection may be absent despite the existence of an undoubted luxation. The limitation of abduction—a sign of great importance—may easily pass unnoticed, and this is particularly liable to happen in bilateral luxations where asymmetry of form and range of movement do not come to our aid. We are compelled therefore to face the situation that many cases of congenital dislocation—in the infant more accurately described by the term subluxation or preluxation (Hohmann, 1951)—are likely to escape discovery until the child has walked for a little time or even later. This is perhaps inevitable in countries where the deformity is uncommon. In populations where a high incidence is genetically determined, as in Northern Italy, it is a legitimate social policy to encourage all mothers to bring their female infants for inspection during the first six months, a precaution which is imperative for mothers known to have been treated for the deformity in childhood.

In 4 cases in my own small series of luxations treated in infants, the mothers were 'congenital hip' victims; 3 of them had been treated in childhood under my own direction (*Figs.* 492, 493). The fourth was an Italian born woman with bilateral subluxations, now grossly arthritic, first seen at the age of 9 at the Rizzoli Institute, Bologna, and in accordance with the practice at that date rejected as unsuitable for open reduction. Before her baby was born she exacted a promise that the infant should be examined and the hips radiographed as soon as conveniently possible. This infant, treated for an unmistakable congenital dislocation (or preluxation) on a divaricator for five months, and now 4 years old, presents a hip-joint indistinguishable from the normal (*Figs.* 494, 495). Such uncommon experiences should encourage us to remain on the alert and to seize every opportunity of emphasizing the importance of early diagnosis to medical students, undergraduate and postgraduate, to medical officers in charge of infant and child welfare clinics, and to nurses, physiotherapists, social workers, and others concerned with the welfare of children.

My own experience during the past decade suggests that the numbers of early diagnoses are increasing, though the pace of advance is still very slow. As I have said elsewhere (1956), until the time comes when the majority of congenital hip dislocations are recognized in the first few months of life, orthopædic surgeons must continue to practise and perfect the techniques of both closed and open reduction.

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CAVITY AND OTHER GRAFTS

By BALCOMBE QUICK, D.S.O., Melbourne

In 1872 Ollier, of Lyons, described a method of applying free grafts of skin to unhealed surfaces under the title of "Greffes cutanées ou autoplastiques". Within the next two or three years Karl Thiersch, of Leipzig, had written a number of papers upon the same subject and the epidermic graft has since come to be known by their joint names. It is by no means without precedent for a long-forgotten procedure to be re-discovered. Nearly two thousand years earlier Celsus had written upon free grafts to the eyelid in the treatment of ectropion, and it was for the relief of this same condition that Wolfe, of Glasgow, in 1875 reported the successful use of a full-thickness graft. This short paper, however, deals with some uses of the epidermic graft alone.

Fig. 496.—Osteomyelitis of os calcis, with involvement of astragalo-calcaneal articulation and part of astragalus. Multiple sinuses. 1941.

Something more than mere coincidence was probably responsible for the almost simultaneous publication by Ollier, of France, and Thiersch, of Germany, of similar methods in the treatment of granulating surfaces. The Treaty of Frankfurt had been signed, but the wounded of the Franco-German War still filled the hospitals and, as has ever been the case, the stimulus of war led to progress in surgery.

But until the Great War of 1914–1918 there was no great advance in plastic procedures, which remained very largely within the domain of the general surgeon. That war was responsible for the development of plastic surgery as it is known to-day—a very special field of activity. New methods of approach to old problems were devised—the Esser epithelial inlay and Stent graft, for example. Old procedures were re-discovered and modified—the tubed pedicle of Gillies being the lineal descendant of the Italian Tagliacozzi's rhinoplasty, almost forgotten for three hundred years—and plastic surgery began to assume the position of importance which it now occupies. Its boundaries are ill defined and elastic and impinge everywhere, not only upon general surgical practice but, in addition, upon most of the special departments which have emerged from the gradual dismemberment of the parent.

Fig. 497.—The bilateral approach is shown. The tendo Achillis functions despite its isolation. (*Figs. 496, 497 by permission of the publishers of "Australian and New Zealand Journal of Surgery".*)

The general surgeons of that period, upon whom, prior to the full development of plastic units, devolved the treatment of casualties of all types, eagerly adopted these new methods of obtaining skin cover and making good tissue loss and extended their use to allied problems in civil surgery.

At their inception much of the work of the plastic units lay in the field of maxillo-facial surgery, and McIndoe and others have described in detail the applications of cavity grafting in the reparative surgery of the mouth—perhaps its most important field—orbit, nose, and ear.

BONE CAVITY GRAFTS

Of special concern in both military and civil work in the post-war period, because of the resulting prolonged invalidity, was the unhealed bone cavity. The great majority of these were due to shell or bullet wounds or compound fracture; a minority followed an acute osteomyelitis. Many of these cavities did not lend themselves to the accepted methods of treatment by planification or the swinging of flaps of muscle or fat. Sheer lack of space

as well as the difficulty of securing their fixation in the depths ruled out the use of pedicled skin-flaps. Here, then, seemed a possible field for the application of the thin split-skin type of graft on an accurately moulded Stent inlay. It was fully realized that this type of graft is unable to stand up to trauma, however slight. But on the other hand it seemed unlikely that in such a sheltered position it would be exposed to injury of any kind. In a considerable series of such refractory cavities the results

FIG. 498.—Condition 16 years later.

have appeared to justify fully this belief. Included and illustrated in a paper (Quick, 1943) on the method employed, and reproduced here (*Figs.* 496, 497), is the case of an osteomyelitic cavity involving the os calcis and adjacent talus. The evil reputation borne by bone infections in this situation in pre-antibiotic days is well known and the problem of its treatment was frequently declared insoluble, short of dismemberment. Although complete healing was secured within a month by the application of Stent grafts from both sides, doubts were freely expressed by most observers as to its permanence. The result some sixteen years later is also shown (*Fig.* 498). There is no disability and a full-time and arduous occupation has been followed throughout. It will be noted that the considerable tunnel through the heel has so narrowed as to now barely allow the passage of a probe. Such filling up is commonly seen in bone cavities treated in this way.

The only difficulty likely to be encountered in the use of this method is that of displacement of the graft upon the mould during its introduction into the cavity. When initial adhesion has been secured by a smear of blood upon the mould the whole is frozen by spraying with ethyl chloride so that no slipping can occur at that time. A complex and irregular cavity may call for a divided mould.

The original method employed by Esser in his epithelial inlay for the restoration of a lost sulcus was by an approach from below the chin—through a completely sterile field. But the proven ability of a free epithelial graft to survive upon a by no means sterile bed, as evidenced by the success both of the Sidcup oral approach and of bone-cavity grafts, suggested the possibility of using a split-skin graft of this kind in a more ambitious project—the restoration or re-formation of a tube or duct—again in a non-sterile field.

Lack of complete sterility would obviously be the determinant of success or failure. The formation of an artificial vagina in this way is an accepted procedure, and McIndoe has described in detail the successful use of a free epithelial graft for the formation of a penile urethra in adult hypospadias. In this operation a length of catheter is dressed with a Thiersch graft and loaded into a special trocar and cannula which is thrust through the tissues ventral to the corpora cavernosa. Both these operations, however, are carried out in a sterile field.

REPAIR OF THE URETHRA

The opportunity for attempting to re-form, or restore the continuity of, the urethra in a very definitely unsterile region presented itself in 1944. Several weeks before coming under the writer's care a young countryman was thrown from his horse and sustained a fractured pelvis, the urethra being torn across in the prostato-membranous region. Pelvic extravasation of urine and gross infection followed and the loss of alinement of the urethral segments was complete, as is not uncommon in the neglected case.

Control of the sepsis by chemotherapy and penicillin in the very small dosage then in use was followed, after a delay of several months and, it must be admitted, two earlier and very badly planned operations, by the successful placement of a free epithelial graft which restored the continuity of the widely separated ends of the torn urethra (Quick, 1956).

Returning then to his home in another State, he was not seen again for twelve years. He was then found to have no urinary or genital disability of any kind, a full stream of clear urine being passed under full control, and he is the father of two children. It is especially noteworthy that there has been no instrumentation of any sort in the intervening years.

Contraction of Grafts.—It has been generally accepted that all grafts, from the sheerest of epidermic to the whole skin of Wolfe, are subject to shrinkage or contraction, either immediately or later. This tendency is obviously of first importance where the lumen of a tube is in question.

In the thin epidermic graft primary shrinkage is so slight as to be negligible, for no elastic fibres are included in it. The cause of secondary shrinkage is to be found: (1) in the organization, by maturation of the invading fibroblasts, of the fibrinous layer thrown out by the recipient base in attaching the graft to itself; and (2) in the contraction of such other scar tissue as may have been already present in the base.

The measures to be taken to limit, as far as is possible, this secondary contraction with its potentialities for harm will be, first and foremost, preparation

of the bed by the removal of all possible avascular scar tissue; next, complete hæmostasis in the bed so prepared; then the maintenance of close contact between graft and bed; and, finally, such immobilization as is feasible in the particular case.

An awareness of the general tendency to contraction will suggest, moreover, that any new lumen should be planned upon a generous scale.

The removal of all possible old scar tissue is of the highest importance and the failure of the first attempt in the case cited was in part due to lack of appreciation of this fact. Of such operations Winsbury-White (1948) has written, "Ruthless removal of this mass is the first step". Correction of this error and the placement of a graft of greater calibre combined to secure the lasting freedom from stricture formation which this young man has enjoyed.

THE PROBLEM OF THE DAMAGED COMMON BILE-DUCT

In the year following this urethroplasty the writer's hospital appointment terminated and thus the much desired opportunity of applying

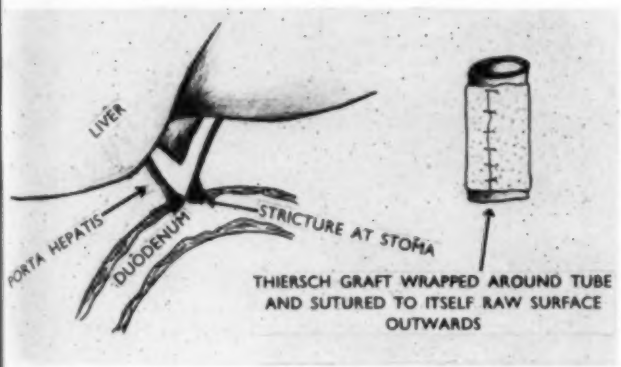

FIG. 499.—Case of Mrs. A. G. Diagram of condition found at operation (pin-hole stoma) and, inset, the Thiersch-dressed tube.

a similar procedure to a damaged common duct became an unlikely event. That such a repair might be successful was suggested not only by the outcome of the urethroplasty, but also by the recollection of an unhappy incident in his earlier days.

A cholecystectomy was in progress when the discovery was made that a forceps had been clamped for several minutes squarely across the common duct just below the cystic junction. When the forceps was removed the crushed portion of the duct resembled a really thin Thiersch graft, the tenuous walls being in intimate union. Teasing them apart restored a lumen, but it seemed that no vascular supply could possibly have survived the injury and that little more than the epithelial lining remained. The operation was completed in the usual way and a full recovery, both immediate and long-term, followed. Although the actual continuity of the duct had not, in this case, been interrupted, it was a sorely battered portion that had proved itself to be still viable when once more within the shelter of the lesser omentum. It seemed not unreasonable to ask if a free graft playing such a part and occupying such a position might not have proved equally competent.

My colleague, Mr. L. H. Ball, who had practised bone-cavity grafting for a number of years, knew of my continuing interest in the surgery of the common duct and shared, I found, my belief in the feasibility of such a method of repair. In November, 1955, he invited me to see with him Mrs. A. G., aged 52, whose history, very briefly, was as follows:—

In June, 1953, cholecystectomy with injury to the common duct. On exploration in July a stricture in the lower portion of the common duct was found and choledochoduodenostomy was carried out. This was followed by recurring attacks of painless jaundice, itching, and pyrexia, but without rigors. When admitted to Alfred Hospital in November, 1955, she was a thin woman, slightly jaundiced, the skin covered with scratch marks, her liver hard and reaching the level of the umbilicus. Blood-chemistry: serum-bilirubin, 3·0 mg. per cent; alkaline phosphatase, 96 units; but prothrombin was, nevertheless, 100 per cent of normal.

At operation on Nov. 27, 1955, the stoma of the choledochoduodenostomy (of July, 1953) was found contracted to pin-hole size. Through a transduodenal

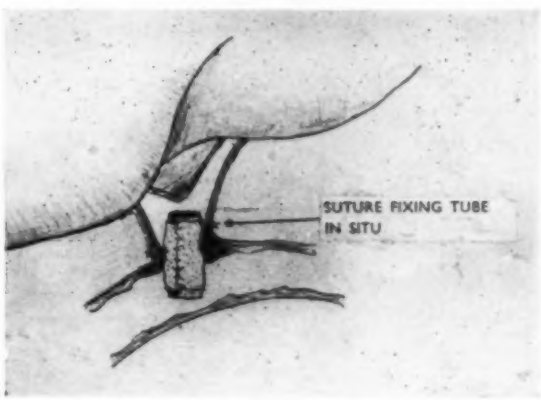

FIG. 500.—In dividing the stricture from within the direction of division was towards the free border of the lesser omentum. The gap resulting from this division is indicated by the absence of heavy shading on that side of the enlarged stoma.

approach the strictured orifice was divided and dilated from within. Troublesome hæmorrhage was experienced at this stage from some injury to the portal vein. Fortunately the placement of the Thiersch-dressed rubber tube, 1¼ in. long and ⅜-½ in. in diameter, acted as an efficient hæmostatic and no further trouble of this kind was experienced. The dressed tube was sutured in position, traversing the enlarged stoma, with fine thread. Interrupted sutures of thread were also used in the application of the graft covering of the tube. (*Figs.* 499, 500.)

A liver biopsy was taken and reported upon as: "Biliary cirrhosis showing marked bile-duct proliferation with infiltration of portal tracts by inflammatory cells. Histology compatible with biliary obstruction."

Following operation the serum-bilirubin fell steadily and convalescence was uneventful, the tube being passed per anum on the nineteenth day. The last bilirubin estimation (March 12, 1957) showed it to be 0·2 mg. per cent. When seen on May 16 the only complaint was of inability to put on weight. The whole liver is hard and grossly nodular, the right lobe being slightly smaller than before operation, the left now extending below the level of the umbilicus.

The history of Mrs. I. A., a stout woman of 60, when in June, 1950, her gall-bladder was removed, is a very similar one:—

During the operation her common duct was divided, but it is not clear if it was a simple transection or a segmental resection. The injury was recognized at once and an end-to-end repair carried out. Within a few months there was complaint of pruritus, and three months later she became jaundiced. In March, 1951, the serum-bilirubin was 0·5 mg. per cent. By June the jaundice had deepened, the liver had enlarged by three finger-breadths, and the serum-bilirubin had risen to 10·5 mg.

At operation the site of repair of the divided duct was found to be strictured and the remainder of the duct, that distal to the stricture, was so fibrosed that a choledochoduodenostomy was performed over a rubber tube.

An interval of good health followed this operation, but then recurring attacks of jaundice led to further operation in December, 1955.

The dilated common duct, from point of origin to anastomosis with duodenum, was less than an inch long, even after fullest mobilization of the duodenum, was possible. The finding of the lower segment, that distal to the point of division or stricture formation, is always difficult in secondary operations. It may be shrunken and fibrotic far beyond the actual point of injury, possibly as a result of damage to its blood-supply.

When the lower segment evades discovery and an alternative choledochoduodenostomy (or -jejunostomy) becomes inevitable, it is suggested that the lower vertical arm of the T-tube should be dressed with a Thiersch graft for a distance of 4 in. or so to enable its burial in Witzel fashion in the duodenal wall. In this way some measure of valved entrance will be brought about.

The Graft Itself.—It is essential that the graft should be truly epidermic, with a complete absence of hair follicles. The thinner the graft, moreover, the less its nutritional demands and the more certain the 'take'. The freehand cutting of a graft ¾ in. wide and 4–5 in. long should present no difficulties, and one of such dimensions lends itself well to application in spiral fashion. A tube dressed in this way will show no bare areas and a single suture at each end is sufficient for fixation.

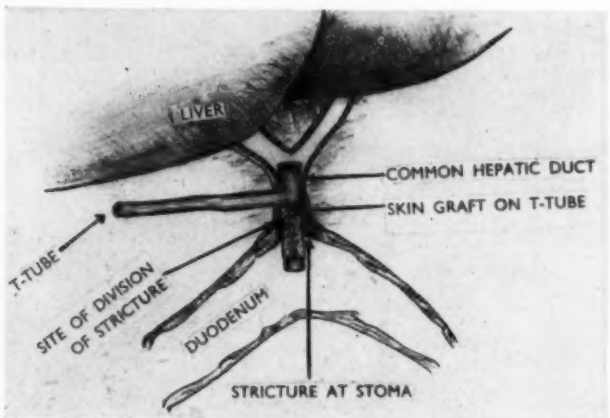

FIG. 501.—As in *Fig.* 500 the gap resulting from the division of the stricture is indicated by the absence of shading on that side.

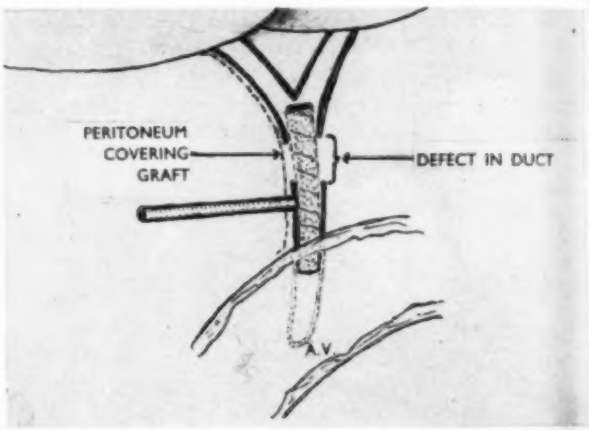

FIG. 502.—Arrangement suggested when distal common duct is available. The spiral arrangement of the graft is indicated.

the duodenum being sharply drawn up towards the porta hepatis. On opening the duct the gush of bile carried with it some hundreds of small black pigment stones. The main site of stricture formation appeared to be just proximal to the site of the former stoma (Aird, 1957). It was not possible to pass a sound through this either from above through the opened common duct or from below by transduodenal approach. After division and dilatation of the stricture by the latter route a dressed T-tube was inserted, as shown in *Fig.* 501.

Her convalescence was satisfactory and on discharge, with the T-tube in situ, it was arranged that it should be retained for six months.

A competent clinician, reviewing her in May, 1957, found her to be in excellent condition except for a hyperpiesis. The question of liver size remains unresolved, a gain of weight of 3 st. making any accurate observation difficult.

In both these cases the condition calling for relief has been a failed choledochoduodenostomy. The method has not been applied to the repair of an extensively damaged or strictured duct of which, however, it is still possible to find and utilize the distal portion, and thus, with the help of a bridging graft, to restore continuity. In such a case the arrangement of the parts, after any necessary excision of the affected segment, would be as represented in *Fig.* 502. It would be equally applicable in the event of immediate discovery of such operative damage to the duct that no simple end-to-end repair,

Whether absorbable or non-absorbable sutures are used in duct sutures will depend upon the particular purpose to be served, remembering always that unabsorbable sutures, unless certainly withdrawn with the removal of the T-tube, may prove a source of danger.

Although stress has earlier been laid upon the necessity for the removal of all possible scar tissue from the bed in which the graft is to be placed, the anatomy of this region must impose limits to this preparation.

It is obviously important that the graft should be well buried, either by careful closure over it of the peritoneal gap or by bringing omentum up for this purpose. In this latter event it may be convenient to bring the horizontal limb of the T-tube out through the omentum.

It is assumed that prior to operation any metabolic deficiencies will have been corrected and that steps will be taken, at operation, to ascertain if the biliary tree is harbouring pathogens, so that any

suitable chemotherapeutic or antibiotic cover may be given.

So many of the methods which have been advocated for the treatment of injury to the common duct have involved union under tension. Any success so attained will never be a lasting one. Little better in long-term results is the use of a retained metallic or plastic conduit.

Whilst it is freely admitted that the follow-up of 18 months is too short for the passing of a final verdict, it would seem that the results so far in the cases here recorded have been sufficiently encouraging as to warrant further trial.

Acknowledgement.—My sincere thanks go out to my friend and former colleague, Mr. L. H. Ball, for his interest in, and confident acceptance of, an untried method in the treatment of his patients.

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MORPHOLOGICAL VARIATION IN HYDATID DISEASE

BY SIR HAROLD R. DEW, SYDNEY

A STUDY of the various manifestations of hydatid disease in both man and the herbivora emphasizes its protean nature. This paper reviews some of these variations and an attempt is made to explain their occurrence.

IN THE SHEEP

In the sheep, which may be regarded as the ideal intermediate host, multiple infestations of great variety are common. The typical cyst is univesicular and in the liver particularly it is fertile, resembling except as regards size those seen in young human subjects. There is a well-formed laminated membrane, while the adventitia is clearly defined from the surrounding tissue and is relatively thick and avascular. Unlike cysts in the human, daughter cyst formation is very rare—perhaps this is due to the fact that the sheep is a short-lived host. Multilocular cysts with loculi varying in size from a few millimetres to a few centimetres in diameter with a central common cavity are also common. Sometimes these loculi seem to become secondarily excluded and small congeries of cysts may form. Degenerative changes are very common in these, the small cavities becoming filled with pseudocaseous debris. The adventitious layer may be very thick, dense-like cartilage, and often shows some calcification. Multicystic forms also appear, resembling very closely those seen so typically in the ox, the cysts being very small, containing little fluid, usually being sterile, with poorly developed laminated membrane, often in a state of collapse or fragmentation. Usually these show degenerative changes both in the cavities and in the adventitia and when washed free of debris give a honeycomb-like appearance (*Fig.* 503).

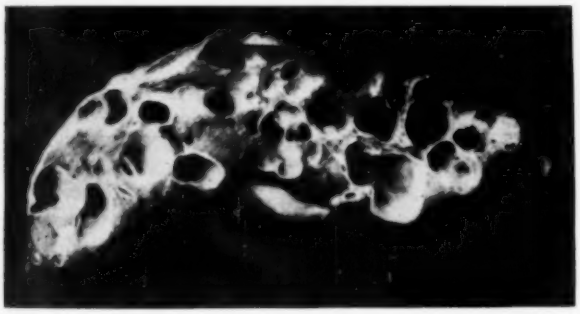

FIG. 503.—Multiple hydatid cysts of liver of sheep showing some variations.

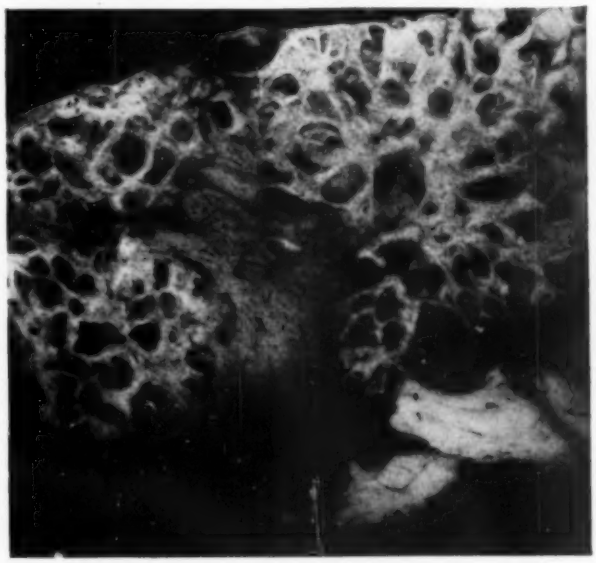

FIG. 504.—Typical multicystic lesions of the ox (*Echinococcus multilocularis*).

IN THE OX

In the ox the same variety of cysts may be met with as in the sheep, although typically the lesion shows a multicystic arrangement with much surrounding fibrosis. Simple univesicular cysts, when present, are usually in the lungs and even these are often sterile; in fact, the frequency of sterility in bovine cysts in all sites has been commented on by all observers. The laminated membrane is often thin and poorly developed in relation to the size of the cavities and is loosely applied to the inner layer of the adventitia. This surface may be lined with a thin layer of yellow caseous-like material, while degeneration of the whole lesion with death

of the parasite is common. Very occasionally one finds typically fertile cysts and even endogenous daughter-cyst formation. The adventitia in all bovine cysts is well marked, but is more cellular and less dense and rigid than is the case with similar cysts in the sheep. Multilocular cysts closely resembling those seen in the sheep and characterized

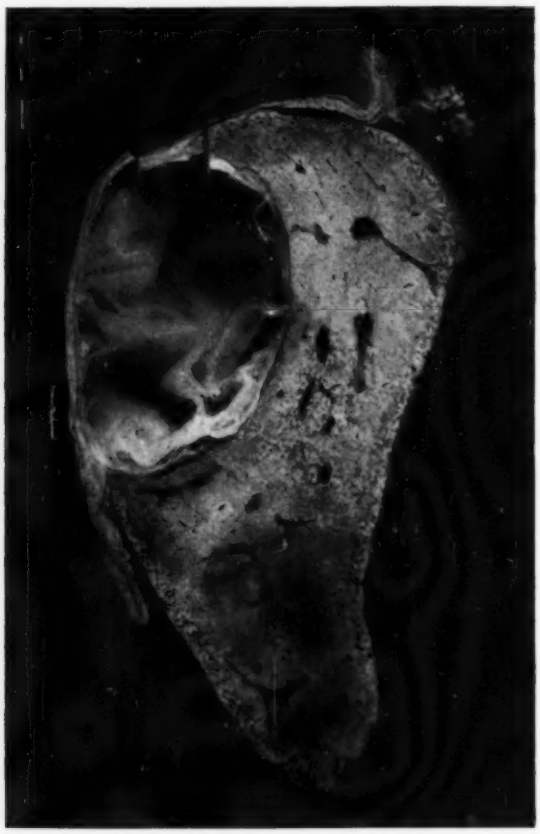

FIG. 505.—Simple fertile univesicular cyst of human liver.

by a thick adventitia, sterility, and degenerative changes are very common.

Multicystic forms are so typically found in the ox, particularly in the liver, and have such a special structure that they have been called '*Echinococcus multilocularis*'. These take a great variety of forms, usually that of small congeries of cysts from 1 to 10 mm. in diameter separated from each other by thick bands of fibrous tissue with all degrees of degeneration (*Fig.* 504).

Sometimes very complex lesions are seen; dense fibrous trabeculæ may make up most of the lesion, while the enclosed irregular spaces may be full of debris. In all these lesions the parasitic activity seems to be very low; they rarely, if ever, show active scolical formation. In many cases the whole lesion seems to be quite non-progressive and to be undergoing fibrotic exclusion, so that it is very difficult to be sure that the parasite is really alive. The cellular reaction of the tissues of the ox to the parasite is very different to that usually seen in the sheep or in the human being. Even in simple cysts the cellular reaction is definite and persistent, the cells being arranged more or less in three zones, while in old lesions too, in which the parasitic elements are obviously dead, there is often some residual cellularity in the adventitia.

The laminated membrane in these complicated cysts is usually thin and folded in an irregular manner, but may still contain a small amount of fluid which is under a relatively low pressure. This gives the impression that this membrane has lost some of its semi-permeable selective nature and that it is not capable of retaining the specific fluid at the appropriate high pressure. Probably as a consequence of this change in the hyalin membrane, we may find projections of the inner layers of the adventitia in the form of small papillæ. These may be rudiments of future septæ.

IN THE HUMAN SUBJECT

All observers have also been struck by the extreme variety shown in human infestations. This is probably due to more accurate and detailed descriptions and to the longevity of the host. Typically in young subjects we find simple and univesicular cysts with well-marked laminated membrane, clear hydatid fluid, brood capsules and scolices surrounded by a firm, inactive, fibrous adventitia. As in the typical cysts of the sheep, there seems to be a perfect symbiosis between the parasite and the host tissues (*Fig.* 505).

Endogenous daughter-cyst formation is common and is a feature of older cysts in most situations. Most observers agree that this is probably a protective reaction in cysts in which the laminated membrane of the original mother cyst has for some reason or other become inefficient. Some scolices under these conditions have the potentiality of becoming vesicular and forming daughter cysts which are small replicas of the original mother cyst. In this way the parasite is enabled to survive, to produce a fresh batch of scolices, and so to preserve the species. There is a great deal of pathological, experimental, and clinical evidence which bears out this contention.

In addition to these typical and common forms many other peculiar appearances have been described. It would take too much space to describe them all, but such forms as multilocular cysts, forms showing excessive tissue reaction, tuberculous-like masses in the peritoneum, and excessive hyalin production can occur. Peculiar formations due, as is the case with osseous cysts, to the nature of the tissue in which the cysts are growing are also well known.

In bone the form assumed by the parasite is certainly due to the peculiar non-resistant nature of the surrounding bone. As a rule the parasitic embryo comes to rest in the marrow or in a bony canal and it is forced to grow along the canals in a diverticulated manner (*Fig.* 506).

Slow-pressure absorption of bone, and secondary exclusion of some of these small cysts, which look rather like boiled sago, can take place, the excess fragmented hyalin material being removed by phagocytosis. When the parasite extends into a wider cavity or into the soft tissues it tends to assume a typical hydatid appearance. In the past there has been a good deal of controversy concerning the nature of bone hydatid, but there is no doubt that it is typical hydatid disease modified by the site.

One sometimes finds in the same patients typical cysts of the liver, and if allowance is made for the different rate of growth it is obvious that these cases are examples of multiple infestation by similar parasitic embryos at the same time.

Echinococcus alveolaris.—This peculiar form of hydatid disease was first really recognized by Virchow in 1856. All are aware of its peculiar nature and appearances. These are so remarkable

FIG. 506.—Section of bone hydatid (human) showing multiple diverticulated growth. (× 24.)

that it is little wonder that for a long time its hydatid nature was not fully realized and it was even mistaken for a low-grade form of mucoid carcinoma. It shows many minute irregular cavities containing crumpled or discoloured hyalin membrane, all enclosed in a relatively avascular fibrous adventitia (*Fig.* 507).

The cavities contain little or no fluid, scolices are very rarely seen therein, and in some areas there tends to be a lack of true encapsulation. This is so marked and the lesion is so irregular at its periphery with quiet extension into nearby tissues that a pseudo-malignancy has been attributed to it. Central necrosis with the formation of a cavity containing brownish or in hepatic cases bile-stained fluid is common. Some cases have been described in which the lesion has invaded lymph-glands and venous channels with the production of distant embolic lesions. There is a surprising uniformity in the appearance, both macroscopically and microscopically, of all these lesions, whether primary or secondary.

The whole appearance of these lesions, and the fact that most of the recorded cases have occurred in subjects of middle or advanced age, supports the view that they are of relatively old standing.' They suggest very slow growth, and this disease is in my opinion an example of persistent parasitic growth at a low level rather than of real activity or pseudo-malignancy. I am in complete variance with some writers as regards their degree of activity. The large size of some, the thickness of the sclerotic tissue, the presence of calcareous change, the breaking down in the centre, and the relatively quiet nature of the tissue reaction in many parts all support this view.

The Question of More than One Parasite.—A school soon arose which advocated and strenuously argued in favour of the doctrine that there were two separate adult parasites. There can be no doubt—all observers in all countries believe this—that the lesions so commonly seen in sheep, ox, and man are the larval forms of the same parasite. They occur in such great numbers in all these hosts, occur widely in all countries, and there is no doubt that the

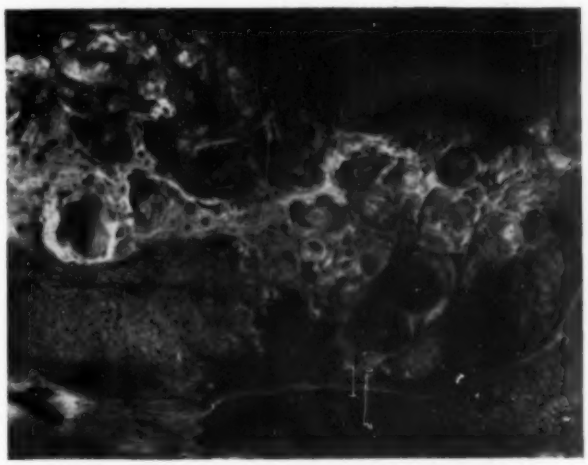

FIG. 507.—*Echinococcus alveolaris.* Australian case.

ordinary life cycle—sheep, dog, secondary hosts—is universal. The sheep is undoubtedly an ideal host for the parasite, and it is certain that the dog is practically always infested by eating the viscera of this animal. While the above has always been admitted by all, some find it impossible to believe that *Echinococcus alveolaris* particularly was also derived from exactly the same parasite. This is not the place to review at length the controversy nearly a century old which was carried on with a good deal of heat at times between the two schools of thought, the monists and the dualists. The dualists, led by Posselt, had always maintained that the alveolar form is confined to the human subject and that it is the larval form of a distinct tænia. They introduced arguments based on morphological appearances, and brought forward some unsatisfactory experimental work to try to prove their case. They laid particular emphasis on what has been called the 'geographical' argument, as it soon became established that this human form was relatively common as compared to the normal hydatid form in a rather narrow geographical area in Central Europe. They also pointed out that it was apparently unknown in the classical hydatid countries—Iceland, Australia, New Zealand, and South America. Dévé, the doyen of hydatidologists, was for a long time a dualist. The monists, however, pointed out that there was no proof whatever that two distinct parasites existed and they countered with an unanswerable argument—that if the disease was confined to human beings, and as dogs do not have access to human flesh, how could the life cycle be completed

and the parasite kept from becoming extinct? Thus each side had a powerful argument in its favour and the literature on the subject is a very voluminous and interesting one. It has been reviewed by Dévé (1912) and the writer (1931), and the reader is directed to these articles for fuller information. It was gradually discovered that this special form of the disease did not have the very narrow geographical distribution attributed to it by the dualists. Cases were discovered in many parts of Europe far from the main centre of distribution, while cases have also been recorded of proved native origin in South America, New Zealand, Great Britain, and Iceland. I recorded the first Australian case in 1931, and this case has been reviewed by Dévé (1934).

I had always championed the monist view, which I believe was originally suggested by Virchow, that there was nothing in any of the forms of hydatid disease which could not be explained by the occurrence of parasitic variation. Dévé, who had been wavering for some time and who had carried on for years a controversy with Posselt and his school on several other aspects of the disease, finally joined the monists. After his personal study of the first Australian case he saw that the only argument advanced by the dualists which was apparently unanswerable—the geographical argument—was no longer of real value. Although there were still some interesting facts to explain concerning the distribution of the alveolar form of the disease, he came to the conclusion that the monist doctrine was correct. Posselt, however, remained a dualist even in the face of Dévé's brilliant paper (1934) in which he compared several of Posselt's reported cases with the Australian case I reported. The case reported from New Zealand by Meade and Barnett (1941) produced additional evidence in favour of the essential unity of the species, particularly as the case showed a round spherical cyst of some size with an associated area showing typical alveolar structure.

The occurrence of these cases in typical hydatid countries, the proof that transitional types could and did occur, aided by the conversion of Dévé, who quickly became an ardent champion of the doctrine of the essential unity of hydatid disease, have, I consider, completely dispelled the long-held conception that more than one species of adult parasite exists.

The above review, short and necessarily incomplete, emphasizes the extraordinary varied phenomena shown by this disease, whether in the same or in different hosts. Were a pathologist who had had no experience of this pleomorphism shown all these lesions he would, I think, find it very hard to believe, what I am sure is true, that they are all manifestations of the larval form of the same small tænia.

Theoretical Considerations.—If the essential unity of the hydatid species is admitted, and I think most workers now admit this, all the above forms, simple and bizarre, are different forms assumed by the larval stage of the same parasite. It is important to consider both the way in which they are produced and, what is more difficult to explain, why they come about. Essentially all these lesions have many points in common. In all there is a parasite which is composed of active nuclear germinal membrane which elaborates a hyalin protective coat, and which produces varying amounts of fluid and, under normal conditions, reproductive elements in the form of scolices. In all there is a part played by the host in the formation of a protective controlling adventitia. All the lesions, therefore, have a parasitic and a host component; both the components are interdependent, and in order to understand their relationship it is important to go back to the earliest stage of the development of the larval form itself. When this is studied in the experimental animal it is found that during the first week the embryo shows active cellular division and growth and produces diffusible toxins which may cause toxic and inflammatory changes in the surrounding tissue. The latter may go so far as to cause local cloudy swelling or actual cell necrosis. At the same time there is a typical antihelminthic cellular response in the accumulation of granular eosinophil leucocytes. This cellular reaction may overwhelm the young parasite and some early experimental follicles appear to be composed almost entirely of leucocytes and extravasated blood-corpuscles. The presence of isolated pieces of hyalin with peculiar staining reactions in some of these follicles suggests that the parasite had actually been fragmented. In the parasite that survives 14 days, the embryo shows the beginnings of vesiculation and the cellular reaction, though still marked, is not nearly so severe and is beginning to assume a trizonal arrangement.

At 21 days after infestation the parasite shows still further differentiation into two layers—an inner germinal nuclear membrane and a very thin outer laminated membrane, while fluid has been formed so that a small true hydatid cyst is present. The surrounding cellular reaction is now trizonal, the inner layer being composed of endothelial-like cells arranged somewhat radially, the middle layer being composed of lymphocyte and leucocyte cells which extend loosely into the inner zone of the outer layer. The outer layer is a typical early fibroplastic reaction, merges into the cells of the surrounding tissue, and is, of course, the first step towards the formation of a true fibrous adventitia. The tissue cells beyond the outer layer show little evidence now of any toxic changes. The only change seen in the cells of the host is a mild degree of pressure atrophy (*Fig.* 508).

At four weeks the laminated membrane is well differentiated and tends to curl up in sections. The cellular reaction is much the same, though the zones are beginning to merge somewhat while the cystic space is now a little larger.

The steady persistence of the active cellular reaction around the parasite seems to be largely a response to the diffusible toxins of the parasite. It is possible that the quiet reaction of the tissues to pressure may also be a factor, but as the weeks go by the reaction gradually disappears. At three months most of the reaction has died down, the eosinophil cells have disappeared, and the trizonal arrangement has practically gone, although there may still be a narrow zone of radially arranged cells of endothelial type close to the laminated membrane. All of these, however, gradually disappear, and at the end of a few months the whole wall of the follicle has been converted into avascular fibrous

tissue and assumes the characteristics of typical adventitious tissue.

As the parasite grows a perfect balance is normally struck between it and the host ; the fibrous adventitia allows sufficient nourishment to permeate to the parasite, the hyalin laminated layer acting as a selective membrane to control absorption. This also acts as a protective barrier for the parasite and prevents the escape of specific fluid into the tissues of the host. This membrane is composed of laminæ of hyalin laid down by the germinal membrane, the only active part of the parasite, so that the outer layers having been laid down first are gradually put on a greater stretch than the inner layers with a differential tension that causes the cyst to turn inside out when ruptured. Insufficient attention has, I think, been given to this very interesting membrane and I think further studies of its development, structure, and function should be undertaken.

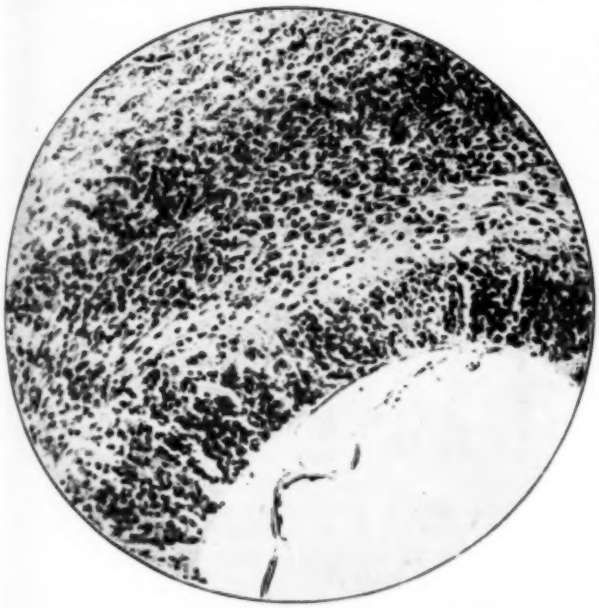

FIG. 508.—Experimental hydatid follicle at 21 days, showing formation of a cyst and the trizonal arrangement of the cellular reaction. (× 75.)

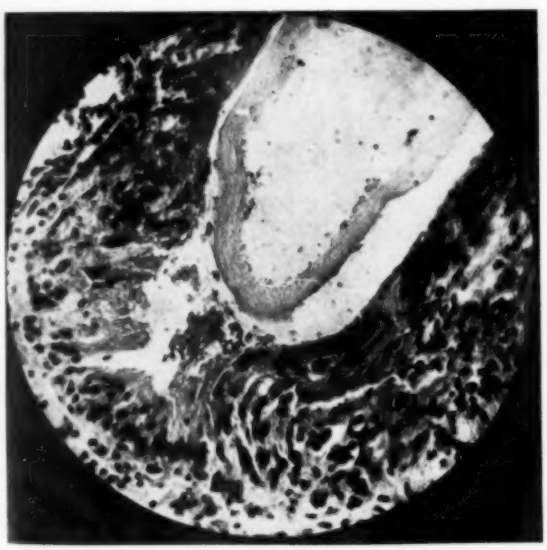

FIG. 509.—Cellular reaction with trizonal arrangement from multilocular cyst of the ox. (× 120.)

The importance of retaining fluid within the cyst at a high tension must be realized, because this has a buffer and protective effect, and provides suitable conditions for the development of scolices.

When one examines the above-mentioned abnormal types of hydatid disease we find, in some cases in the reactive tissues of the host, what appears to be a reversion to the type of reaction seen in the early stages of larval development. Thus in multiloculated cysts of the sheep we sometimes find that, at the apex of some of the small pouches which are apparently associated with local weakening of the laminated membrane, a trizonal cellular reaction in the inner layers of the adventitia tissue. The most likely explanation of this is that it is caused by quiet leakage of toxins from the parasite.

In the ox a similar trizonal arrangement in the cells of the inner layers of the adventitia is almost universally seen in all cysts which are still alive (*Fig.* 509).

This feature has been commented upon by numerous observers and it may be regarded as typical of the multicystic forms in this animal.

The inner zone is composed of endothelial-like cells which are arranged in palisade formation, close to the laminated membrane. These cells are large, with small active nuclei, and may even show a resemblance to columnar epithelium. Giant cells of various types, some plasmodial, others somewhat resembling those of tuberculosis, are common. They

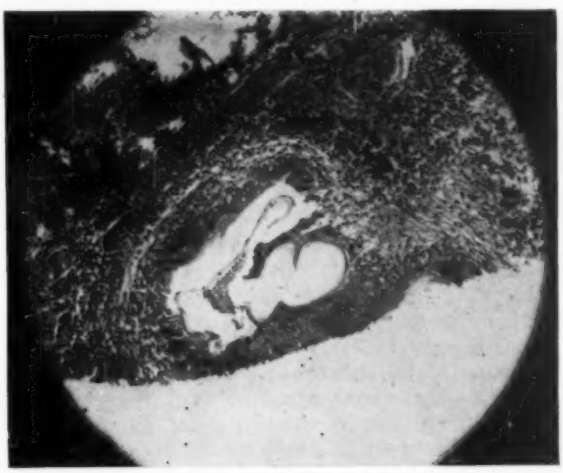

FIG. 510.—Section of *Echinococcus alveolaris*—peripheral extending region—showing deficient hyalin and persistent trizonal cellular reaction. (× 25.)

are probably due to persistence of the endothelial cells which are found in the earliest stage of the hydatid follicle and thus form part of the protective reaction of the host. They almost certainly have phagocytic function, can often be seen surrounding pieces of separated hyalin, and they may also play a part in elaborating the collagenous material which is laid down in the adventitia. The second layer consists mainly of lymphocytes and leucocytes, some of which are eosinophile. This zone becomes more

cellular as the inner zone is approached. The third outer zone is composed of connective fibrous tissue concentrically arranged and may show some degree of calcareous deposition. At the periphery the cells merge gradually into the cells of the affected organ.

In *Echinococcus alveolaris* many of the spaces are surrounded by a complete fibrotic adventitia and it would seem in many cases that the parasite was, if not actually dead, just managing to survive. In this form cuticularization by the germinal membrane may be irregular, delayed, or completely absent from some parts of the parasite—contrasting greatly with ordinary hydatid disease. This is particularly so in those peripheral parts of the lesion where the disease is obviously alive and actually extending. Sometimes one sees what are apparently naked prolongations of the nucleated germinal membrane in direct contact with the host tissues.

It is interesting to note that the South American observers, Llambias (1919) and Parodi (1922), who were able to examine very early forms in the ox, described granular extensions of what was apparently germinal membrane with no hyalin covering resembling the small projections so typically seen and similar to those which have been described by a number of observers in the alveolar form of the disease. Although Dévé has criticized some of the findings on histological grounds, I have seen similar appearances in the ox. This deficiency in hyalin covering suggests the possibility not only of the quiet escape of hydatid fluid—these lesions normally contain little fluid—but also of a toxin from the germinal cells themselves. That there is a persistent stimulation of the cells of the host tissues is borne out by the active reaction, which is usually trizonal, as in the other cases (*Fig.* 510).

It is obvious that in the above peculiar forms of the disease in the sheep, ox, and man there is a tendency towards a type of cellular reaction very like that seen in the first weeks of development of the typical cyst. This and the fact that transitional forms of the disease can and do occur regularly suggest that the differences between the multiloculated and the alveolar forms is almost certainly one of degree only.

In these special types of lesions there are several outstanding common characteristics. They are :—

1. An abnormal condition of the parasite in that it is usually sterile, contains fluid under low pressure, and often shows gross degeneration ; in many cases it is apparently just managing to survive at a relatively low level of activity.

2. A surprising degree of deficiency in the production of the hyalin laminated membrane—all gradations of this deficiency existing.

3. A tendency towards persistent cellular reaction by eosinophil and endothelial cells in the surrounding tissue.

The most important common factor, and one upon which all the other characteristics depend, is the lack of an adequate protective laminated layer. On this depends the failure to retain fluid, with the formation of complete cysts in which conditions are suitable for the production of scolices, so that here we have an explanation of the frequent sterility. This deficiency probably leads to the steady leakage of hydatid fluid together with the possibility that the semi-naked parts of the germinal membrane itself may also be active and cause a constant reaction by the cells of the adventitia in an attempt to halt and confine the parasite. It is only in those cases in which the laminated membrane is well established that we get a successful balance between the host and the parasite, a balance which in itself means that conditions are favourable for fertility. In the alveolar form we find that the lesion is much more persistent, with a tendency to quiet spread into the surrounding tissues in a patchy sort of way. This lesion, then, is not so readily halted by the host tissues, and although the reaction may be so dense in some parts as to interfere with nutrition so that the centre breaks down, in other parts the lesion still quietly progresses. This particular lesion is almost invariably of long standing and, as mentioned above, I regard it as a lesion which is just managing to survive. What makes it so serious is that it does not form a distinct confining capsule like other forms of hydatid disease, while it may rarely invade veins.

Why do these forms appear?—I suggest that the common feature of all these bizarre forms is the partial failure of the parasite to form a definite hyalin laminated membrane and that upon this the pleomorphism of the disease depends. The problem of parasitic variation leads one into a very controversial field. It is well known, of course, that in the adult stage abnormal forms of the cestodes are very common indeed. Such forms are bifid bodies, or fenestrated proglottides, shrunken or misshapen forms, forms with absence of hooklets or deformed hooklets, and others with gross changes in internal anatomy are apparently common. It is known, too, that the larval form of *Tænia solium*, the *Cysticercus cellulosæ*, which may occur in various animals may show great variety in its appearances. Reports from parasitologists with regard to other parasitic variation have, of course, often been made. When one considers the many millions of parasitic ova, all of which are potential larval forms, it should cause little surprise if from time to time abnormal forms appeared. It is quite possible that we are dealing with pathological changes in the parasite itself, as there is no reason to suppose that animals of this type should be quite free from intrinsic disease processes.

It may be, of course, that the loss of the power of hyalin production may be characteristic of the parasite, acquired during the definitive tænia stage, and that it has a deficiency disease of tænia metabolism. It may be that the biochemical structure of hyalin varies, and I have no information of any very accurate chemical studies of laminated membrane from various sources. It may be that in the ox and possibly other animals there is some deficiency in the supply of the correct amino-acids necessary to produce this substance, and this may be the reason that makes some hosts relatively unsatisfactory for the parasite. I think it may be taken that parasitic variation must occur more frequently than we thought and that it might explain why these bizarre larval forms do sometimes appear, although it would not explain the fact, so long used by the dualists, that alveolar disease is rare in Australia and South

America, where the typical disease is so common, and relatively common, although the total number of cases of all hydatid disease is not great, in the countries of Central Europe. Many suggestions can be found in the literature by various exponents of the two great doctrines. It has been suggested that climatic conditions in some countries, particularly severe cold, mode of life, and food supply of the inhabitants, telluric conditions, or some other vague factors which are at present unknown, may have an effect on the vitality of the adult worm, its ova, or its larval forms, and that this may tend to produce pathological changes in larval development.

It has, of course, also been suggested that infestation of human subjects may be brought about through the medium of some definitive host other than the dog, but no conclusive evidence of this point is as yet forthcoming.

I wish to put forward tentatively a suggestion that perhaps the idea put forward by Posselt, confirmed dualist though he was, that the people of Central Europe were infested through the medium of the ox acting as an intermediate host, has something to recommend it. There is no doubt that practically all dogs in the so-called hydatid countries at least are infested from eating fertile cysts of the sheep, the most commonly slaughtered host and the ideal herbivorous host. Few humans in these countries can be infested indirectly from bovine sources, largely because the cysts in this animal are so often sterile, and infestation of the dog by this method must be very unlikely indeed. In those countries of Europe where the *alveolaris* variety is most commonly seen, relatively few sheep are pastured or slaughtered, as compared with the common domestic animal, the ox. It is conceivable in these countries that a few dogs may be infested from the ox, and this may be an explanation of the fact that hydatid disease as a whole is not common and that abnormal forms are proportionately more common. Is it not possible that passage of the larval form through the ox in which hyalin production is so often deficient may transmit to the adult form and so to future larva an acquired defect in the anabolism of hyalin? There is no doubt that neither Australia or New Zealand nor South America have imported diseased oxen or dogs from the countries of Central Europe at any time, so that it is unlikely that this peculiarity could have been transmitted there in this manner, but it is possible by chance that even these dogs eating fertile bovine cysts may on rare occasions become infested and occasionally pass on abnormal forms to man. The chance of this happening in countries where so many sheep are pastured and slaughtered would, of course, be very small and it may be that this is the reason why so few cases of alveolar disease have been reported in the countries of the Southern Hemisphere.

The foregoing survey of pleomorphism in hydatid disease still leaves us with a few interesting, though academic, problems. There are some lines of investigation which might prove fruitful. They are the following :—

1. A careful recording and study of all abnormal or bizarre forms of hydatid disease, particularly in man, as regards aetiology, particularly the possible sources of infestation of the dog responsible.

2. Complete studies, including carefully controlled transmission experiments, of the sylvatic infestations with this disease such as have been recently recorded by veterinarians in Canada and Europe.

3. An experimental attack by infesting young dogs with the rarely-fertile cysts of the ox. This can be done if care is taken to have adequate controls and should be followed by the feeding of ova from the tænia thus obtained to young sucking pigs. If a big enough infestation could be obtained it might be possible to ascertain whether morphological variations could be so produced.

4. A further study of the early experimental cyst with particular reference to the development of the hyalin laminated membrane. This should be combined with a much fuller study of the biochemical properties of this interesting structure.

Acknowledgements.—I have to acknowledge the use of illustrations which have recently appeared in articles in the *Medical Journal of Australia*, the *Australian and New Zealand Journal of Surgery*, and in the *Archivos Internacionales de la Hidatidosis*.

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HYDATID DISEASE OF THE BRAIN

WITH A REPORT OF TWO CASES

By R. A. MONEY

FROM THE DEPARTMENT OF NEUROSURGERY AT THE ROYAL PRINCE ALFRED HOSPITAL, SYDNEY

HYDATID disease of the brain is comparatively rare and up till 1948 only 29 cases had been recorded in Australia and New Zealand during the previous 60 years (Phillips, 1948). Complete and satisfactory previews of the mode of infection, pathology, and clinical features have been reported on several occasions by Dew (1928, 1934, and 1955), Hailes (1936), Langmaid and Rogers (1940), Phillips (1948), and Miller and Fleming (1948).

These aspects of the malady will not be discussed further as nothing new has since emanated, but the following two cases are reported in detail on account of the different and interesting features presented by each, and the opportunity of gaining additional information concerning prognosis from the happenings during the follow-up periods. Both cases have already been mentioned by Dew (1955) as forming part of a series of 10 cases of primary cerebral hydatid disease, presented at Santiago, Chile, in 1952, with the present author's permission.

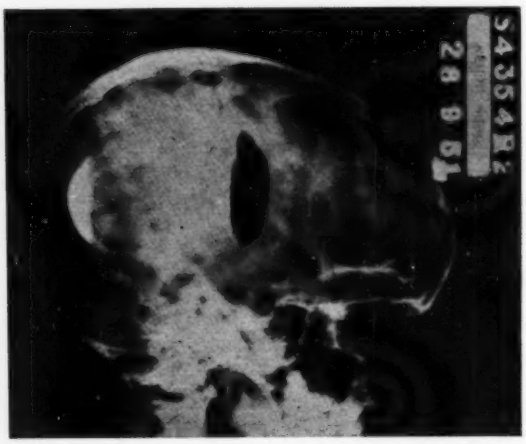

FIG. 511.—*Case* 1. Cystogram (thorotrast and air) of occipital cyst.

CASE REPORTS

Case 1.—A boy (P. B.), aged 7, had been referred by Dr. J. H. Coles. He had been born and reared on a mixed farm near Goulburn, N.S.W.

In July, 1951, he had been admitted to the Goulburn Hospital with pneumonia and a radiograph of his chest revealed a large rounded shadow in the upper lobe of the right lung, diagnosed as a hydatid cyst. The Casoni reaction was positive.

As soon as the pneumonia had subsided, he was sent home to await a bed in the Thoracic Unit at the Royal Prince Alfred Hospital, Sydney.

During the next few weeks, he began to complain of severe headaches, and vomiting occurred with increasing frequency. He also noticed double vision.

On Sept. 20 he was admitted to the Department of Neurosurgery of the Royal Prince Alfred Hospital. He had a large head. The circumference was 22 in. There was a 'cracked-pot' note on percussion, but there was no bruit. Bilateral papillœdema was present and there was a complete left homonymous hemianopia with macular sparing. The visual acuity was very poor, being only 6/36 in the right eye and 6/60 in the left eye.

Radiographs of the skull showed a marked degree of 'thumbing' with wide sutures; and those of the chest showed the same rounded shadow in the upper lobe of the right lung, referred to above. The blood-count revealed an eosinophilia of 3 per cent of 10,000 white cells per c.mm., and again the Casoni reaction was positive.

FIG. 512.—*Case* 1. The large hydatid cyst removed from the right occipital lobe, and consisting of ectocyst and endocyst.

An electro-encephalogram recorded some generalized slow wave dysrhythmia with extensive delta rhythm from the right posterior parietal region.

In view of the above findings further investigations were considered to be superfluous. On Sept. 29 a right occipital craniotomy was performed. The dura mater was under great tension and could not have been opened safely, so, at a depth of 2 cm., the cyst was tapped and about 40 c.c. of clear fluid removed. This fluid did not have any hydatid elements. The chlorides were 630 mg. per cent and the protein content was less than 20 mg. per cent. Two c.c. of thorotrast were introduced and the wound was closed.

On the next day cystograms were taken and the extent of the cyst could be clearly seen in a brow-up lateral radiograph (*Fig.* 511). The air must have got in at the time of aspiration.

On Oct. 4 the second stage of the operation was undertaken. The dura was opened widely and the thin cortex over the cyst in the right occipital lobe was incised. As much as possible of the cyst was exposed. It would not have been possible to remove it intact without causing extensive damage to the brain, so the cyst was opened, its fluid contents evacuated, and the large ectocyst, with its endocyst, pulled out (*Fig.* 512). The surrounding adventitia was well developed and was dissected out as far as possible to help the cavity collapse. No daughter cysts were seen and no formalin solution was instilled into the cavity.

During the operation the hydatid cyst in the lung ruptured, and the airway became seriously obstructed until a lot of hydatid contents had been sucked out from the trachea. Despite this complication the operation was completed and the wound closed.

His subsequent convalescence was uneventful, and when he left hospital on Oct. 20, all the abnormal signs had disappeared except the left homonymous hemianopia. The visual acuity had improved in the right eye but not in the left.

In March, 1952, he was re-admitted to hospital and the remains of the hydatid cyst were removed from the right lung.

He was not seen again until Jan. 13, 1956, when he was referred because he had taken an epileptiform fit about three weeks previously. Examination of his central nervous system did not reveal any abnormalities except for optic atrophy in the left eye, with only a little vision in the lower half of the nasal field. The visual acuity in the right eye was 6/12 and the temporal field was full, with macular sparing.

He was re-admitted to hospital, where investigations by lumbar puncture, examination of the cerebrospinal fluid, and pneumo-encephalography excluded the presence of further hydatid cysts. There was a big traction diverticulum of the right lateral ventricle out into the remains of the occipital lobe, where the cortex was very thin. An electro-encephalogram recorded some generalized slow waves, with wave and spike complexes from the right parieto-occipital region, suggesting epilepsy from an atrophic lesion rather than a space-occupying one. Dilantin was prescribed and he was allowed to go home. Up till March, 1957, he had not had any further fits.

Comment.—In this case the diagnosis was at once suspected owing to the age of the patient and the presence of a hydatid in the lung. The lesion was readily localized by ordinary neurological examination.

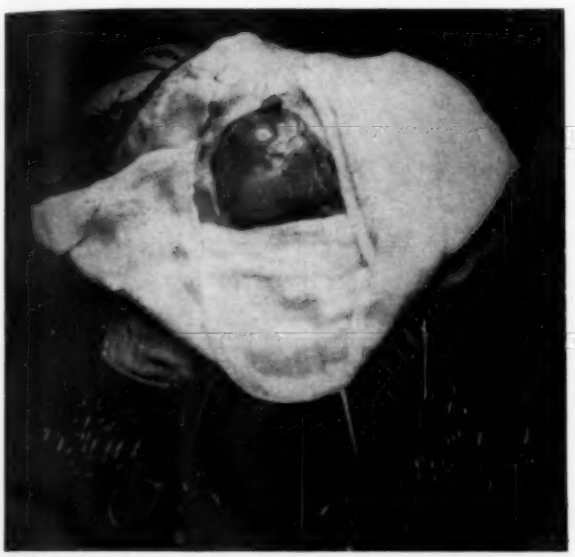

FIG. 513.—*Case* 2. Showing the daughter cysts under the arachnoid after reflection of the dura mater.

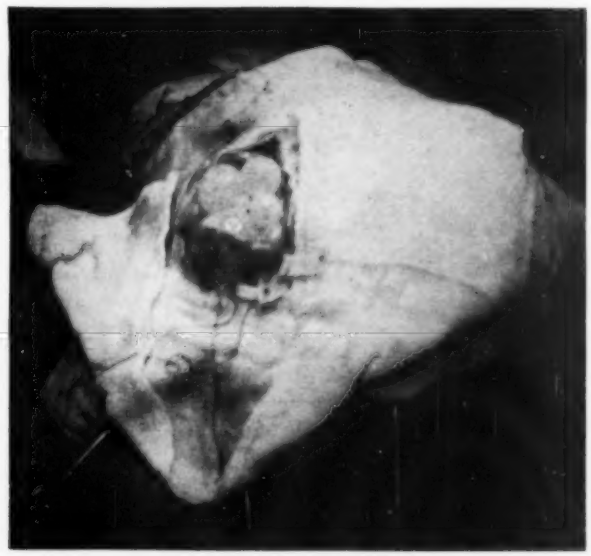

FIG. 514.—*Case* 2. Daughter cysts being extruded as the flap of arachnoid is being reflected.

FIG. 515.—*Case* 2. The main cyst presenting after all the daughter cysts have been removed.

FIG. 516.—*Case* 2. The main cyst being aspirated to reduce its size and aid removal.

A two-stage operation was considered advisable on account of the very high intracranial pressure, and the taking of a cystogram helped in the planning of the second stage, although it was not strictly necessary.

The removal of the cyst did not present any major difficulties from a technical point of view, but the rupture of the parent cyst into a main bronchus could easily have ended fatally but for the presence of mind of the anæsthetist in realizing what had happened.

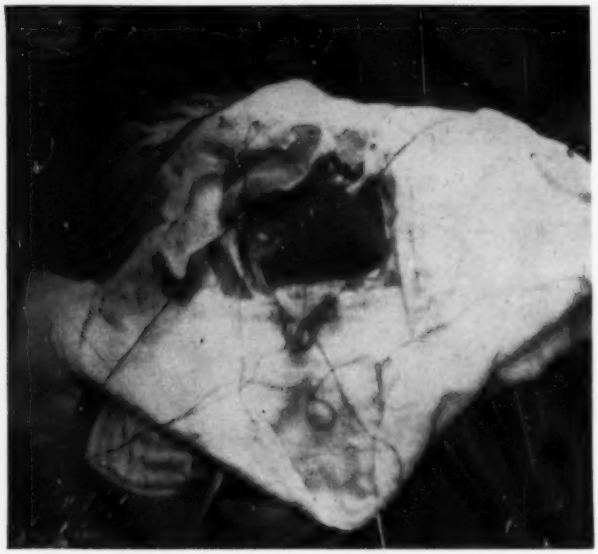

FIG. 517.—*Case* 2. The cavity in the left parietal lobe after removal of the main cyst.

The occurrence of the epileptic fit, some four years and three months after the operation, was not altogether surprising as the patient had not reported at intervals for routine electro-encephalogram recordings and had not been taking any anticonvulsants.

The adventitia had been very thick, and where it had been removed some damage had inevitably been done to the underlying cortex by its presence, by the pressure exerted by the cyst, and during its removal. It is trusted, however, that with mild sedation, the fits will be kept under control.

Case 2.—A boy (R. S.), aged 7, was referred by Dr. R. Jackson. He had been born and bred on a sheep station near Armidale, N.S.W., and had always been fond of dogs.

About Christmas, 1951, it was noticed that he had developed an awkward gait, with some weakness in the right knee and some foot-drop. Early in January, 1952, he fell out of a tree, after which some weakness of his right hand was noted. He was regarded as having had a mild attack of poliomyelitis and a course of massage and physiotherapy was started.

Early in February, 1952, an orthopædic surgeon found that the left plantar reflex was extensor and advised a neurosurgical consultation. About this time the patient began to complain of daily headaches and he vomited at irregular intervals.

On examination on Feb. 13, 1952, the patient had a large head with an obvious bulge in the left parietal area; a 'cracked-pot' sound and sensation were noted on percussion and a loud systolic bruit could be heard on auscultation. There was advanced bilateral papillœdema and there was an incomplete right homonymous hemianopia. He walked with a spastic ataxic gait and there were signs of a right hemiparesis and hemianæsthesia. The right knee-jerk was ++ and had a pendulum character. The right plantar reflex was very definitely extensor. Plain radiographs of the skull showed a localized thinning and expansion of the bone in the left parietal area. Radiographs of his chest were normal.

An electro-encephalogram recorded slow waves in the left parieto-occipital region, and this slow activity extended into the left temporal lobe.

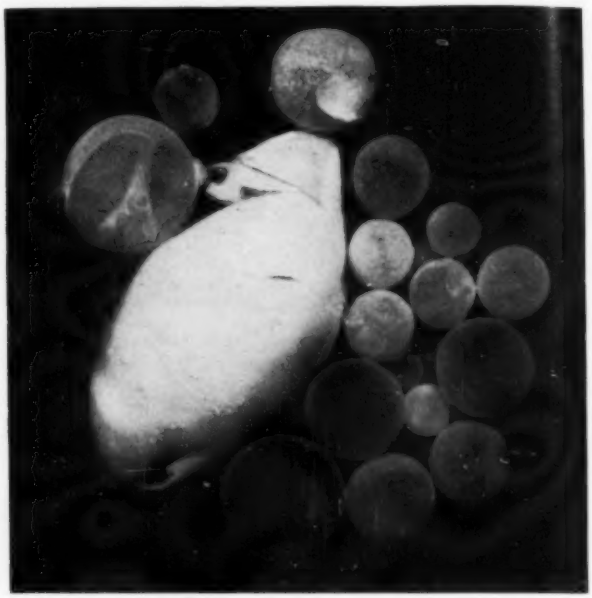

FIG. 518.—*Case* 2. The main cyst, collapsed, and the daughter cysts after removal.

The blood-count was normal, without eosinophilia. The complement deviation test for hydatid disease was positive, but the Casoni test was negative.

A provisional diagnosis of a hydatid cyst in the left parietal region was made; and as the site was so definitely localized by the above findings, exploratory operation was advised without further investigations in view of the obviously high intracranial pressure.

On Feb. 21 a large parieto-occipital bone-flap was turned down, to include the bulge in the left parietal bone. The underlying dura was very thin and numerous hydatid daughter cysts could be seen through it. They became more obvious when this thin dura was peeled back off the pia arachnoid, to which it was attached (*Fig.* 513). The sagittal sinus was displaced across to the right of the midline. The thin pia arachnoid was then dissected back and removed and the daughter cysts began to roll out (*Fig.* 514). Several different sizes were noted, and twenty were counted. They were all intact. The parent cyst could then be seen with the small opening in it, through which the scolices, which subsequently developed into the daughter cysts, had been extruded (*Fig.* 515). It was still full of clear fluid. About 60 c.c. of this fluid was then aspirated to allow its delivery intact (*Fig.* 516). Despite this precaution, it ruptured and some of its contents were spilt. A huge cavity was then exposed, being 10 cm. in its largest diameter (*Fig.* 517). It was filled carefully with a 2·5 per cent solution of formalin which was allowed to remain for two minutes and then washed out with Ringer's solution, with which it was finally filled. The dura mater was then replaced and the scalp wound was closed in two layers.

The fluid from the main cyst was examined for hooklets, but none was found; and no hydatid material was seen in the removed portion of pia arachnoid. The collapsed main cyst and the twenty daughter cysts were kept as museum specimens (*Fig.* 518).

Convalescence was uneventful, and when the patient left hospital on March 1 the papilloedema was subsiding, the fields of vision were full, and his gait was almost normal, except for a minor degree of spasticity and foot-drop in the right leg. The intracranial bruit had disappeared. The right plantar reflex was indeterminate.

A second electro-encephalogram on May 6 still showed the presence of slow, 3–4 cycles per second, waves from the left occipito-parietal region, without any definite epileptic tendencies, but it was decided to prescribe phenobarbital gr. ½ to be taken night and morning. He has been followed up at yearly intervals since then and he has remained well and developed normally, except that in May, 1953, he got the right foot caught in a tractor with some loss of skin and with other signs of a crush injury which resulted in a valgoid deformity.

The last electro-encephalogram recorded on May 15, 1956, showed slow waves of 3 cycles per second in the occipital regions, mostly on the left side, with some paroxysms of high-voltage 3 cycles per second waves and spikes, so that it was felt that epileptic fits could occur. The giving of phenobarbital has been continued, without any ictus to date.

Comment.—This case illustrates the difficulty in making an early correct diagnosis where the presenting sign is paresis of one or other lower limb. The obvious 'bulge' and thinning of the left parietal bone pointed to the presence of a slowly growing tumour of a simple nature; and his upbringing on a sheep station and fondness for dogs were strong indications of hydatid disease. The negative Casoni test was disturbing, as it should have been positive in view of the findings, but the positive complement deviation test was reassuring in arriving at the provisional diagnosis.

The operative approach through the large bone-flap enabled the whole of the parent cyst and its extruded daughter cysts to be removed, and the toilet of the cavity to be carried out carefully under vision. There was practically no adventitia and none was removed except where it involved the arachnoid on its superior surface.

The cavity was a very large one; it extended from the sagittal sinus to the Sylvian fissure, under the motor cortex. The compressed convolutions of the insula, covered with normal pia mater, could be seen in its depths.

The multiple daughter cysts, up to 2 cm. in diameter, had probably developed from scolices shed through the small hole in the laminated membrane of the parent cyst and thus represented a case of localized secondary echinococcosis. The parent cyst contained a few brood capsules and degenerating scolices, which were probably inert. There was no history of injury or any episode which would correlate with the rupture of the parent cyst, but minor head injuries in a boy are hard to exclude.

The subsequent history of the case is satisfactory and the patient's physical and mental development has been normal; but the continued abnormalities in the electro-encephalogram are rather worrying and it is felt that epileptiform fits may still occur if sedation is entirely suspended.

The abnormal rhythm is probably arising from cortical gliosis, which formed as a result of the prolonged compression to which it was subjected prior to operation.

Acknowledgement.—The assistance and helpful advice given during the pre-operative and operative stages by Professor Harold Dew, now Emeritus Professor of Surgery in the University of Sydney, are gratefully acknowledged. *Fig.* 511 has been taken from his article on primary cerebral hydatid disease which appeared in the *Australian and New Zealand Journal of Surgery* in February, 1955.

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ANEURYSM OF THE ABDOMINAL AORTA

BY T. HOLMES SELLORS, LONDON

THE introduction of arterial grafting has revolutionized the treatment of aneurysms and rendered other methods more or less obsolete. This particularly applies to aneurysms of the abdominal aorta, which can now be excised and replaced by a graft with a high measure of success. Procedures such as wiring, wrapping with sclerosing substances, and partial excision have only a very limited application.

The first successful record of a patient in whom an aneurysm was resected and a graft inserted is attributed to Dubost, Allary, and Oeconomos, who in 1951 performed the operation on a man of 50 years. Since that time there have been many reports of patients treated in this way and the most notable series comes from de Bakey and his colleagues, who by the end of 1956 had resected 185 abdominal aneurysms. Rob (1955) in this country has recorded 33 examples of resection and anastomosis and there are other accounts of smaller series which indicate that a practical solution to the problem has been achieved.

It is a tribute to surgical progress that a major operation of this nature can be carried out on a middle-aged or elderly patient whose arterial system is seriously damaged and when the aneurysm may already be leaking. Many of the operations have been performed as emergencies against the threat of a catastrophic hæmorrhage. The average operative mortality, which includes emergency cases, is less than 20 per cent, and for several years the survivors of resection and grafting have lived as if they had a normally functioning abdominal aorta.

If untreated an abdominal aneurysm is open to the risk of rupture; indeed two-thirds of the patients suffering from this condition die from sudden hæmorrhage. This is particularly applicable to patients in the younger age group between 40 and 50 years. Colt (1927) has given the average life history of an aneurysm as two years from the time of diagnosis, and in one-third of the cases death occurs within a year. At the other extreme there are occasional records of patients having lived for 7 or 8 years with

an untreated aneurysm, but there is no doubt that whenever practicable operation should be considered.

The common cause of abdominal aneurysm is atherosclerosis. Syphilitic aortitis is rare in the abdomen though it is frequently found in the thoracic aorta. Unger and Poppel (1936), in a collected series of nearly 1500 aneurysms of the aorta, state that less than 10 per cent were abdominal and only 1 in 10 of these was syphilitic.

The effect of atherosclerosis on the aorta is to convert a highly elastic tube into a rigid tortuous structure which is unable to withstand the strains of the arterial pulsation indefinitely without some loss of form. All coats of the vessel are affected: the intima shows patches of thickening and fibrosis, which may become plaque-like areas in which calcification takes place; the elastic tissue and muscular fibres become partially replaced by fibrous tissue; and in the adventitial layer there may be changes in the vasa vasorum which interfere with the nutrition of the vessel wall. When the aorta has become rigid and thickened it is not so well adapted to withstand the stresses of arterial pulsation as it is in its normal elastic state, particularly when there is associated hypertension. Any break or weakening in the structure of the vessel wall leads to a bulging or dilatation, and the damaged area stretches progressively in response to the arterial pressure. As the degenerative process is diffuse there is a tendency for abdominal aneurysms to be fusiform in character rather than saccular, though they are inclined to distend in some areas more than others. Blakemore (1953) has pointed out that the abdominal aorta is well supported at its upper and lower ends, with a long middle section lying relatively unattached. It is in this unsupported area that dilatation takes place, allowing the aorta to bow forwards and to the left.

Though thrombosis within a fusiform aneurysm is less common than in a saccular one, clot formation does occur in the abdominal aorta. Complete obstruction of the vessel is rare as the arterial flow is sufficiently powerful to maintain some form of channel to the lower limbs. The common iliac arteries are often occluded by thrombus, and it is obstruction at this level that reduces the peripheral blood-supply rather than obstruction in the aorta itself.

An abdominal aneurysm rarely develops above the level of the renal arteries and there is usually a centimetre or so of comparatively normal aorta which is of the utmost importance in the surgical treatment of the condition. The cœliac axis and superior mesenteric vessels are usually unaffected, but the inferior mesenteric artery and smaller branches off the dilated aorta are greatly reduced in size or even obliterated. The establishment of collaterals from the superior mesenteric artery is essential for the maintenance of the blood-supply to the lower colon, and the presence of anastomosing arcades to the descending colon may be determined by aortography. In short, it can be stated that in any case of abdominal aneurysm it should be possible to find a more or less healthy upper end below the renal arteries, and at the lower end patent vessels somewhere between the bifurcation of the aorta and the first inch or so of the external and internal iliac branches. De Bakey recorded only four instances of the aneurysmal process involving the upper part of the abdominal aorta in a series of 183 cases. He excised these aneurysms and successfully inserted a graft which was anastomosed in turn to the cœliac axis, the renals, and the superior mesenteric arteries, in addition to the main aortic channel.

With diffuse atherosclerosis it might be presumed that a 'dissecting' aneurysm would be a common occurrence. The circumstances are favourable for lifting off the atheromatous calcified plaque and then stripping open a space between the intimal and medial layers. Local dissection does occur in the abdominal aorta, but the true 'dissecting' aneurysm occurs more frequently in the thoracic aorta and may extend for a considerable length, involving the upper part of the abdominal aorta and interfering with the great visceral and renal arteries.

The majority of abdominal aneurysms occur in elderly men, particularly those with atherosclerosis and high blood-pressure. A proportion, however, do present at an earlier age and these are liable to rupture. Apart from abdominal swelling many aneurysms are symptomless unless they rapidly increase in size or are on the point of rupture. Dyspeptic symptoms are common, but de Bakey has pointed out how often gall-stones, gastric ulceration, and so on are discovered during the course of operation on an aneurysm. The tendency of the swelling to bulge away from the spine makes pain due to vertebral erosion unlikely, but hæmorrhage into the lumbar tissues or sudden expansion produces severe pain which is usually ill-defined and difficult to control. Low backache or a sciatic type of pain is common, and indeed is sometimes the presenting symptom. This pain is due to claudication of the gluteal arteries, and it comes on after walking a certain distance and disappears on rest. In many instances treatment appropriate for sciatica, sacro-iliac strain, and so on has been carried out before the true nature of the condition is realized.

The aneurysm presents as a rounded tumour from below the left costal margin. Its size varies, and though it may have slight lateral mobility it is a fixed mass with a clear outline. Palpation is simplified by the fact that the majority of the patients are thin. The character of the pulsation is not always expansile; thickening of the wall with thrombosis may cause the pulsation to be of the transmitted type, and on occasions it is difficult to differentiate between a tortuous or displaced aorta and a small aneurysm.

The degree of pulsation in the leg arteries is variable; sometimes full pulsation synchronous with the radial pulse is observed; on other occasions one or both limbs show a marked reduction and delay in the pulse wave. The vessels where palpable are hard and tortuous.

Once an abdominal aneurysm has been diagnosed there should be as little delay as possible in considering the possibilities of surgery. Many patients are in poor general condition, with a precarious cardiovascular system and potential renal insufficiency. Clearly there are circumstances which may preclude surgery, but it is surprising how well elderly patients with a constitution that is far from robust withstand operative intervention. The reason for urgency lies in the danger that the aneurysm may rupture; any

sudden onset of abdominal pain should be regarded with suspicion.

Apart from routine investigation of the cardio-vascular and renal systems prior to surgery, the only special investigation that requires comment is aortography. Injection of a radio-opaque solution into the upper part of the abdominal aorta, followed by a series of radiographs in quick succession, gives an accurate picture of the lumen of the aorta and its branches. From the surgical point of view a short length of normal aorta below the renal arteries is desirable and the aortogram indicates the extent of the aneurysm and the limit of occlusion in the iliac vessels. The mesenteric vascular pattern can also be studied with special reference to the blood-supply to the descending colon. Aortography is not without its dangers. The needle point may push a calcified plaque off the inside of the artery or if it lies in the wall of the vessel the sudden injection of dye may strip off the intima and initiate a 'dissecting' aneurysm.

As has been indicated, the only satisfactory surgical procedure is excision of the aneurysm and the insertion of a graft. An aortic homograft has proved to be a satisfactory agent and has been known to function without complications for at least seven years. This is as long as any follow-up has been possible. These grafts are, however, difficult to obtain and may not be available when required. A satisfactory alternative is a prosthesis fashioned in the form of the abdominal aorta and its bifurcation. Polyvinyl sponge (ivalon) moulded into tube form has been used on a number of occasions, but it is difficult to handle and may tear at the suture line. Fabric plastics woven or sewn into tube-form have proved convenient and safe. Such materials as Orlon, Dacron, and Vinyon N have been shown to be non-irritant and their water-repellent character minimizes the risk of thrombosis. When blood enters one of these tubes it seeps through the meshes of the fabric, but this ooze quickly ceases as soon as a thin layer of fibrin is deposited on the inside of the tube. The arterial pressure within the prosthesis prevents it from kinking or being occluded, and though there is continuous search for an ideal replacement these synthetic fabrics have proved reasonably satisfactory.

Dissection of the abdominal aorta requires a large exposure. The vessel has to be isolated at the level of the renal arteries above, and the iliac branches have to be freed below. The choice of incisions lies between a long paramedian incision for a trans-peritoneal approach and a left oblique incision which exposes the aneurysm extraperitoneally. There are considerable advantages in the latter which make dissection over the posterior aspect of the swelling less difficult than with the other method.

The surface of the aneurysm is usually adherent to adjacent structures and the ureter, inferior vena cava, and descending colon may be practically embedded in its substance. Numerous enlarged fleshy glands are encountered on the surface. The only vessels emerging from the anterior part of the aneurysm are the spermatics and inferior mesenteric arteries, which are narrowed or occluded. The first detailed stage in dissection is to identify the aorta and the renal arteries. The right renal vein which passes across the aorta anteriorly has to be freed and gently retracted while the lateral and posterior aspects of the aorta above the aneurysm are freed. A control tape is passed round the relatively healthy but short length of aorta below the renal vessels and attention is turned to the iliac arteries, which are then isolated. These arteries are usually markedly distorted and care has to be taken to avoid injury to the veins and the ureters.

Once control has been established at each end the lateral and posterior surfaces of the aneurysm are dissected free. Every strand that might contain a vessel should be separately ligated. The middle sacral and iliolumbar arteries can often be identified, but the lumbar arteries are not easily recognized. The separation of the inferior vena cava from the aneurysm may be impossible—the vein may only be preserved intact if part of the wall of the aneurysm is left adherent to it. Any tear or minor injury to the great vein should be repaired by fine vascular sutures. The upper aorta should not be clamped until absolutely necessary so as to preserve the blood-supply as long as possible, but the final posterior dissection may only be practicable if the vessels at one end or other are divided and the whole aneurysm lifted anteriorly. If as a result of leaking or hæmorrhage the aneurysm cannot be removed in one piece the upper and lower ends are clamped and the aneurysm deliberately incised and the wall cut away piecemeal.

The divided ends of the aorta and the iliac vessels are then trimmed and a momentary release of the clamps ensures that any intraluminar clot is removed. The iliac vessels should show a reasonable back-flow and 500–1000 units of heparin are injected into each side. The intima of the 'healthy' arteries is rarely normal; atheromatous plaques and areas of calcification are usually present and the outer coats of the aorta are frequently thickened and shapeless.

The graft or tube prosthesis is sutured to the upper end with a series of short 'runs' of an everting arterial type of stitch (000 plastic or silk). The flange that is produced can be 'lashed' by an over-and-over 00000 stitch for greater security. The graft is then clamped and the aortic clamp momentarily released to see if there are any major leaks that require further suture. An everting suture is not essential and a continuous stitch may suffice, but if this is used tears or leaks are more difficult to repair.

The right common iliac (or internal and external iliac) artery is then anastomosed to one leg of the graft by a similar type of suture, though in this case, because of the smaller size of the lumen, an over-and-over stitch is more straightforward. At this stage a sphygmomanometer cuff which has been placed around the thigh at the start of the operation is inflated and the right iliac and aortic clamps are freed. The other branch of the graft is temporarily occluded. There is brisk bleeding from the anastomoses for some minutes until the junctions have distended and tightened up the suture lines. If there is no gross hæmorrhage a swab is placed over each join and gently pressed on for 2–3 minutes; at the end of this time bleeding is usually controlled. The constriction round the thigh prevents too great a fall in blood-pressure during the re-opening of the circulation and during the time that there is blood-loss from the

anastomoses. The blood-loss is variable, probably between half a pint and one-and-a-half pints, and speedy blood transfusion is necessary at this stage.

With the circulation now re-established on one side the junction between the graft and the left iliac artery is carried out. There is usually little blood-loss from this junction after the clamps have been removed.

The graft or prosthesis should be under slight tension. If it is too long it may buckle or bulge. Too short a graft will leave the junctions under excessive tension. Air within the graft is expelled as blood jets out of the suture line. After the anastomoses are blood-tight and the blood-loss has been replaced, the cuffs on the thighs are released.

FIG. 519.—*Case* 1. Aortogram showing the aneurysm with marked diminution of the inferior mesenteric artery outline.

CASE REPORTS

Case 1.—A medical practitioner, aged 55 years, was referred by Mr.—now Sir Henry—Pierre and admitted to the Middlesex Hospital in April, 1955. He had complained of throbbing in the abdomen for the previous two years and had then noticed a pulsatile swelling in the left upper abdomen. He also had pain in the lower sacral region which became worse on walking, and by the time of his admission this had become more severe and was practically continuous. This pain was located in the gluteal folds and came on after walking or standing for some time. On examination the patient was a man of average build and looked comparatively young for his age. In the abdomen there was a slight protrusion to the left of the midline which consisted of a well-defined pulsatile mass. It was difficult to determine whether the pulsation was expansile or not. The blood-pressure was 150/95. Heart size and sounds were normal. In the arms all the pulses were palpable, but the pulses in the legs were delayed in comparison with those in the arms. Renal function was normal and there were no abnormalities of other systems. The blood-count was normal. Both Wassermann and Kahn reactions were negative. Radiography of the heart showed no abnormality beyond a prominent aortic knuckle. There was no evidence of calcification in the abdominal aorta or its branches and there were no abnormalities in the spine and pelvis to account for the pain in the back.

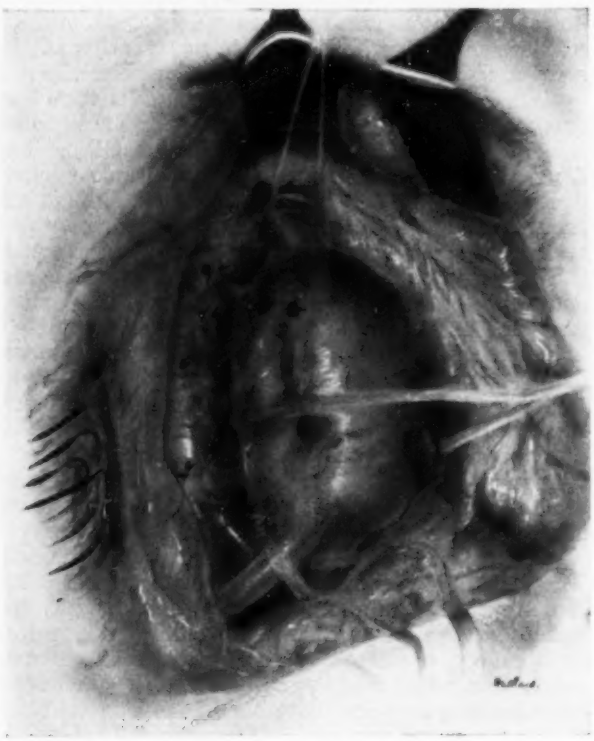

FIG. 520.—*Case* 1. Appearance of the aneurysm at operation.

FIG. 521.—*Case* 1. Homograft in place with completed suture line at upper end and anastomosis in progress at the lower end on the right side.

An aortogram (*Fig.* 519) was performed and this showed a fusiform aneurysm with a thick wall arising below the renal arteries and extending practically to the bifurcation. There was absence of filling of the iliac arteries suggestive of marked arteriosclerotic changes or thrombosis. The divided. The separation of the peritoneum from the posterior wall was straightforward and no retraction was required. The peritoneum was adherent over the diaphragm and perinephric fat. The exposure revealed the anterior and left surfaces of the aneurysm, which

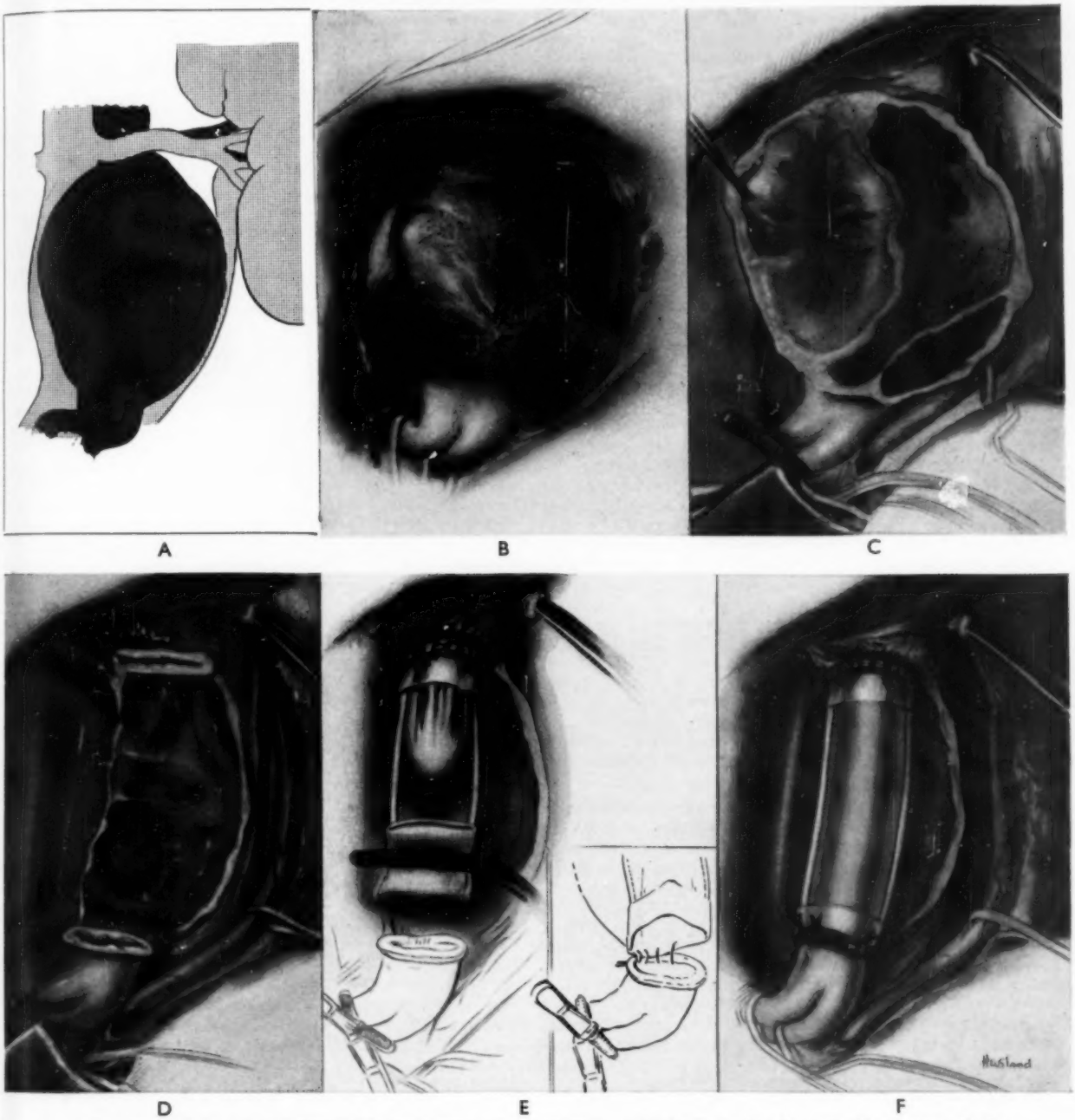

FIG. 522.—*Case* 2. A, Diagrammatic appearance of the aneurysm; B, Aneurysm in situ; C, Upper part of the aneurysm cut away showing areas of extravasation and leakage; D, Aneurysm cut away showing divided ends of the aorta; E, Dacron prosthesis anastomosed to the upper end; F, Completed anastomosis.

other branches of the aorta were normal, though the inferior mesenteric was reduced to a fine thread.

AT OPERATION.—The patient was placed in a half-lateral position so as to expose the left flank. An incision was made from the posterior angle of the 11th rib obliquely downwards and forwards towards the midline of the abdomen to a point half-way between the umbilicus and the pubis. The peritoneum was reflected towards the right after the muscle layers of the incision had been appeared as a purplish structure covered with fat and numerous soft glands. The upper limit of the aneurysm was marked by the left renal vein, which was freed. The renal arteries and adjacent aorta were isolated to reveal ¾ in. of more or less normal aorta below the renal arteries and above the aneurysm (*Fig.* 520).

The spermatic artery was divided, as also the inferior mesenteric and superior hæmorrhoidal arteries which had a common stem. These vessels were so narrow that they

were virtually functionless. The left aspect of the aneurysm was then freed from the vertebral bodies to which it was adherent. Five or six lumbar veins required ligature and the iliolumbar and mid-sacral arteries were also secured. The iliac arteries were freed and encircled with tapes. On the right side of the aneurysm the inferior vena cava was firmly adherent and was opened in two or three places during the dissection. These holes were repaired by suture. The aneurysm was finally freed by dividing three patent right lumbar arteries which were embedded in a mass of inflammatory tissue against the vertebral column. At this stage 1000 units of heparin were injected into the aneurysm.

A homograft consisting of abdominal aorta and long lengths of the iliacs was reconstituted and prepared. Nine or ten vessels arising from it were secured by individual suture. The aorta was then clamped just below the renal arteries and the iliac vessels were secured before the aneurysm was removed. The upper end of the graft was then anastomosed to the aorta by a series of continuous everting sutures of 0000 mersilene. One iliac branch of the graft was anastomosed on to the combined external and internal iliac trunks on the right side with 00000 sutures. Several supporting stitches were required. The upper aortic clamp was then freed and continuity established into the right side while the other limb of the graft was temporarily secured by a bulldog clamp. After suitable trimming this was anastomosed to the left external and internal iliac arteries and the clamps finally released (*Fig.* 521). In all, the circulation through the abdominal aorta was occluded for 1¼ hours. After checking the anastomoses the peritoneum was allowed to fall back in place and the incision sutured in three layers. The time taken for the operation was 5¾ hours and at its completion the leg pulses were present and the lower limbs were warm. Three pints of blood were given during the operation.

To counteract any tendency to ileus intravenous fluids and gastric suction were instituted for the first 48 hours post-operatively. There was some pyrexia for a few days, but otherwise there were no post-operative complications. When he started to walk at the end of a week he found that his legs were warm, almost uncomfortably so, and that the pain of the gluteal claudication had disappeared. When last heard of he had returned to work without any symptoms.

Case 2.—The patient was a man of 62 who was under the care of Mr. D. H. Patey. The first sign of vascular illness was a popliteal aneurysm, which was treated in 1945 by endo-aneurysmorrhaphy. This was not entirely successful and he was later subjected to an amputation of the leg above the knee. Some months prior to admission he had noted in the upper abdomen a pulsating swelling which increased in size. With the increase in size pain developed in the flank and back. This pain was severe and was only controlled with large doses of pethidine every day.

More recently he had had difficulty with bowel action and suffered from occasional vomiting. The swelling became larger and the pain more severe. There was no organic obstruction but there was a suggestion of pressure on the descending mesocolon. The blood-pressure was 170/90 and all the palpable arteries were rigid and tortuous. For the relief of the abdominal symptoms a superior vena caval drip was instituted and continuous gastric suction applied.

At Operation (Aug. 28, 1957) (*Fig.* 522).—A long oblique lumbar incision was made from the 10th rib to the midline below the umbilicus. The peritoneum was opened and explored to exclude any intestinal tumour, but the greater part of the dissection was continued retroperitoneally towards the midline. The aneurysm was the size of a large grapefruit. It was extremely adherent posteriorly and laterally, with the descending colon and left ureter firmly attached to its wall. At several points localized swellings on the surface were threatening to burst. At the brim of the pelvis the tortuous common iliac arteries were dissected free—a process made difficult by dense posterior adhesion due to an organizing hæmatoma from the leaking aneurysm

At the upper limit of the aneurysm the left renal artery was identified as being more or less normal, and on the right the inferior vena cava was stretched like a bowstring and embedded in the surface of the aneurysm. The left renal vein was also adherent and dissected free, and after hazardous dissection the aorta below the renal arteries was clamped. The common iliac arteries were also controlled and the aneurysm deliberately incised. The interior showed a gelatinous clot and a recent hæmotoma which was infiltrating the psoas muscle and spreading down to the pelvis. The only bleeding vessel from the interior of the aneurysm was the middle sacral artery, which was sutured. The aneurysm was cut away piecemeal, leaving part of its wall on the vena cava.

At the upper end a more or less intact tube of aorta was defined, though the intima showed gross atheroma with calcified plaques. An 8-cm. tube of fine woven Dacron was sutured to the stump of the aorta with a series of everting stitches. In the absence of a well-defined aortic wall the flange was then oversewn and the upper clamp was released to test the security of the junction. At the lower end it was possible to preserve the last ½ in. of aorta and to this the other end of the Dacron tube was sutured. On releasing the clamps about ½ pint of blood was lost over a 3-minute period and the blood-pressure fell considerably, but was quickly restored by a 3-pint blood transfusion.

The chest was then closed with a small retroperitoneal drain. The operation took five hours and the patient's condition at the end was satisfactory. The prosthesis functioned adequately and the pulses were palpable in both lower limbs. The patient recovered consciousness in an hour but had some difficulty in breathing, which was helped by oxygen and insufflation. His condition then improved, but suddenly, ten hours after the operation had been completed, he collapsed and died.

At autopsy it was found that there was no bleeding at the operation site and the condition of the prosthesis was satisfactory. There were two or three fusiform aneurysms in the iliac vessels which had been noted at the time of operation. The coronary arteries showed gross atheroma, which practically obliterated the lumen in places, and the presence of a recently displaced plaque of calcium suggested that death was due to coronary occlusion.

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THE SURGERY OF THE THYROID GLAND

By RUPERT VAUGHAN HUDSON
THE MIDDLESEX HOSPITAL, LONDON, W.1

INTRODUCTION

A TOTAL of 1518 personal thyroidectomies in 26 years are few in number (*Table I*). In a teaching hospital with small Surgical Units cases representative of general surgery must be admitted and special surgery strictly limited. During the second World War the function of the Middlesex Hospital was in the main that of a casualty clearing station and very few thyroidectomies were performed.

There was no clinical evidence of an increase in thyrotoxicosis in London during this period.

It is estimated that approximately 5000 patients have been investigated; many were not operated upon either because the diagnosis of thyrotoxicosis was not substantiated or that surgery in non-toxic goitre could be safely postponed—particularly in the youthful—and perhaps some diminution in size achieved by medical means.

The few cases to be described do not include a considerable number of thyroidectomies performed with gratifying results by trainee assistants.

In the main, surgery has been employed for symptoms and signs of mechanical pressure, thyrotoxicosis with or without pressure, and malignant disease. No case, however ill, has been denied treatment.

Thyrotoxicosis.—This work on the sufgery of the thyroid commenced in 1929 in collaboration with the Courtauld Institute of Biochemistry, Professor Sir Charles Dodds, and Dr. Douglas Robertson. It was our wish to devise a safe and certain method of preparation of patients and avoidance of post-operative thyroid crisis. Prior to this, thyroid crisis was common and fatalities followed surgical procedures on the gland or for the removal of a septic focus in the hope of amelioration.

Based on Plummer's work and described in his Foundation Essay, Dr. Robertson devised a dose of iodine administered three times a day to the iodine-free patient, each dose containing 60 mg. of iodine.* Daily pre-operative B.M.R. tests were performed and when the B.M.R. had fallen towards normal limits the patient was operated upon. Daily post-operative B.M.R.s were also employed. From this it was deduced that with toxic goitre in normal rhythm the average duration of pre-operative treatment was ten to twelve days. It was found that the continuation of iodine post-operatively was unnecessary and was abandoned at the end of 1930.

The preparation of patients with arrhythmia was undertaken with great care. The maximum and best tolerated dose of digitalis was established first and those in cardiac failure treated with diuretics to render them dry. Iodine was not commenced as pre-operative treatment until the maximum response had been obtained with digitalis. It was commonly found that as the iodine took affect the digitalis could be reduced in amount. In some thyrocardiacs it was found necessary to continue with iodine for longer than ten to twelve days, fourteen days at least, and in some for three weeks.

It was soon realized that general anæsthesia was unsuitable for toxic goitre, for the first case of thyrotoxicosis and arrhythmia died on the seventh post-operative day from bronchopneumonia. From that

Table I.—AN ANALYSIS OF 1518 GOITRES TREATED BY SURGERY, 1930-1956

Type		Number of Cases	Percentage							Average Age	
			Diffuse	Nodular	Males	Cancer	Deaths	Recurrent Nerve Palsy	Tetany	Diffuse	Nodular
Toxic	Arrhythmia	243	56·8	43·2	28·4	0·4	2·9	0·8	—	48·5	54·7
	Severe	670	77·7	22·2	15·0	0·1	0·3	0·6	0·15	38·6	47·9
	Moderate	132	36·3	63·6	7·5	—	—	0·8	—	38·9	43·4
	Mild	102	3·9	96·1	5·8	3·9	—	—	—	43·3	41·4
	Total	1147	62·0	38·0	16·2	0·8	0·7	0·6	0·09	40·6	47·0
Non-toxic	Arrhythmia	24	100·0	—	25·0	—	—	—	—	48·7	—
	Multinodular goitre	277	—	100·0	21·7	11·2	0·4	1·8	—	—	46·5
	True single nodule	7	—	—	28·6	14·3	—	—	—	—	35·0
	Single nodule and goitre	45	84·4	15·6	13·3	2·2	—	—	—	40·6	46·1
	Complete lymphadenoid	16	100·0	—	6·3	—	—	6·3	—	49·1	—
	Riedels	2	100·0	—	50·0	—	—	—	—	42·5	—
	Total	371	21·6	78·4	20·5	8·9	0·3	1·6	0·0	44·7	46·2
Toxic and Non-toxic	Total	1518	52·1	47·9	17·3	2·6	0·7	1·1	0·07	41·0	46·7

*Haustus Iodi, Middlesex Hospital Pharmacopœia.

time local anæsthesia was used together with a basal narcotic omnopon and scopolamine. Three hundred and sixty-two patients were operated upon without mortality.

A change from local anæsthesia to general anæsthesia was not made until Bernard Johnson was appointed to the Resident Anæsthetist Staff and became interested in the problem. Together we slowly felt our way. First, to the basal narcotic and the local anæsthesia was added gas and oxygen and a trace of ether, but only to those cases with mild or moderate thyrotoxicosis. This was gradually extended to the more severe thyrotoxics, but those with arrhythmia were still operated upon under local anæsthesia. After the second World War and the advent of experienced anæsthetists, the local anæsthesia was gradually dispensed with and has not been used for the past eight years. 'Stealing' of the thyroid was never employed; it is quite impracticable in a general ward.

There have been no cases of thyroid crisis, and no patient has had to be treated in an oxygen tent. This method has therefore been continued and is still considered the method of choice.

Since the introduction of neo-mercazole in 1951, a certain number of patients have been prepared with this drug. Patients under treatment with other antithyroid drugs and sent for surgery have had that particular antithyroid drug continued as a preoperative measure. It is a personal opinion that antithyroid drugs for a short period of time, two to three months, provided it is not goitrogenic, do not increase the vascularity of the gland, for the thyroid may be extremely vascular in those prepared with iodine. The addition of iodine to those prepared with antithyroid drugs has not caused diminution of vascularity. Iodine in these cases has therefore been abandoned for the past two years.

Surgical Procedure.—From the outset the whole gland was exposed and delivered and a one-stage resection performed. The exception was in certain patients with very large vascular diffuse goitres, or in very feeble patients with malnutrition; in these few a two-stage thyroidectomy was adopted. The hemithyroidectomized continued with post-operative iodine until the completion of the second stage, on the average 14 days later.

The remnants were standardized as follows: in thyrotoxicosis and arrhythmia, ¼–½ g. on either side. In thyrotoxicosis in normal rhythm, 3½–7 g., on the average a quarter of a normal thyroid gland. In non-toxic nodular goitre if possible the same amount, 7 g., but in many little relatively normal tissue could be found. In malignant goitre a total thyroidectomy with a block dissection of the neck on the same side as the primary together with the lymphatic chain following the recurrent nerve into the thorax. Permanent post-operative therapy with thyroid extract may be necessary in certain cases and for a period of time in others. In all cases the four main arteries were ligated with silk.

Table II.—THE POSITION OF THE GOITRE IN 1518 PATIENTS

Type		Diffuse					Nodular				
		Total Number	C	C/T	C = T	T/C	Total Number	C	C/T	C = T	T/C
Toxic	Arrhythmia	138	128	8	2	0	105	42	35	17	11
	Severe	521	494	24	2	1	149	71	66	7	5
	Moderate	48	48	0	0	0	84	48	31	3	2
	Mild	4	3	1	0	0	98	42	47	5	4
Non-toxic	Benign and malignant	24	24	0	0	0	—	—	—	—	—
	Arrhythmia	18	12	5	0	1	329	107	127	60	35
	Total	753	709	38	4	2	765	310	306	92	57
	Per cent		94·1	5·0	0·5	0·3		40·5	40·0	12·2	7·5

The Follow-up.—As the cases increased precise follow-up became more difficult owing to lack of assistants. The advent of the Second World War ruined this follow-up. Some patients were killed, others lost their homes or scattered, leaving us without an address. The exact estimate, therefore, of the recurrence rate and degree of myxœdema is not possible, but, based upon the proportion of known cases followed-up, the myxœdema rate is 10 per cent, the recurrence rate in thyrotoxicosis 2·5 per cent, and in non-toxic goitre also 2·5 per cent. In spite, therefore, of radical surgery recurrence is possible. The longer patients are kept under observation the more frequently recurrences are seen. They may occur twenty-two to twenty-five years post-operatively. Thyrotoxic cases may recur as non-toxic. The younger the patient, the more likely and the sooner the recurrence, averaging four to seven years, and these figures are based on our own and the recurrences of others examined in the Clinic. The remnants left behind are goitrous and not normal thyroid tissue, and are still subjected to the stimulus of the original cause of the disease.

THE CLINICAL MATERIAL

One hundred and thirty-five patients had had previous treatment.

Surgery.—Sixty patients had been operated upon elsewhere, 23 non-toxic recurrences and 37 with severe recurrent thyrotoxicosis, some with heart failure: in one patient no less than eight previous operations, in another four, in others at least two. A proportion had had a single lobectomy, the majority too large remnants usually with intact inferior thyroid arteries, others a minor procedure such as enucleation of one or more adenomata with most unsatisfactory results.

X-ray Therapy.—Twenty-two patients had previously been treated by X-ray therapy for toxic goitre. All had either recurrent or persistent thyrotoxicosis.

Thyrogenic Mania.—In 29, all with severe thyrotoxicosis, there was the complication of pre-operative mania. Twenty-four recovered their mental stability and economic position; 5, all of whom had a familial history of insanity, showed no improvement in their mental state.

Antithyroid Drugs.—Fifty-three were failures of antithyroid drug treatment—neo-mercazole 15 cases and thiouracil or methyl thiouracil 38 cases. All had persistent thyrotoxicosis, large, hard, rigid, and very vascular diffuse goitres. *Iodine*: In addition many patients in the early days of this work were admitted with iodine-fast glands identical with the antithyroid treated goitre. Some of these iodine-treated patients died in thyroid crisis prior to the possibility of surgery, others admitted in crisis and iodine-free could be saved by iodine and operated upon within the normal pre-operative time of preparation.

The Position of the Gland (*Table II*) (*Figs.* 523, 524).—As a general rule the diffuse goitre was cervical (C) 94·1 per cent. In nodular goitre only 40 per cent were cervical, the remainder had some part of the gland within the thorax—half the gland (C=T) 12·2 per cent and the major portion (T/C) in 7·5 per cent. In no case has it been found necessary to divide the sternum.

The Pyramidal Lobe is very commonly present and has an abundant blood-supply. This structure always passes through the thyroid notch and the apex is difficult to remove as it passes behind the hyoid bone and is attached to it. Removal is essential or hyperplasia of the remnant will ensue. A tri-lobed goitre can be formed by the base of the pyramidal lobe which joins either the right or left lobe. True ectopic goitres develop in the line of the thyroglossal tract. Two intralingual goitres have been dealt with, and one true ectopic goitre in the hyoid region. In thyroglossal cysts it is important to remove the whole of the pyramidal lobe as well as the middle of the body of the hyoid bone (modification of Sistrunk's operation).

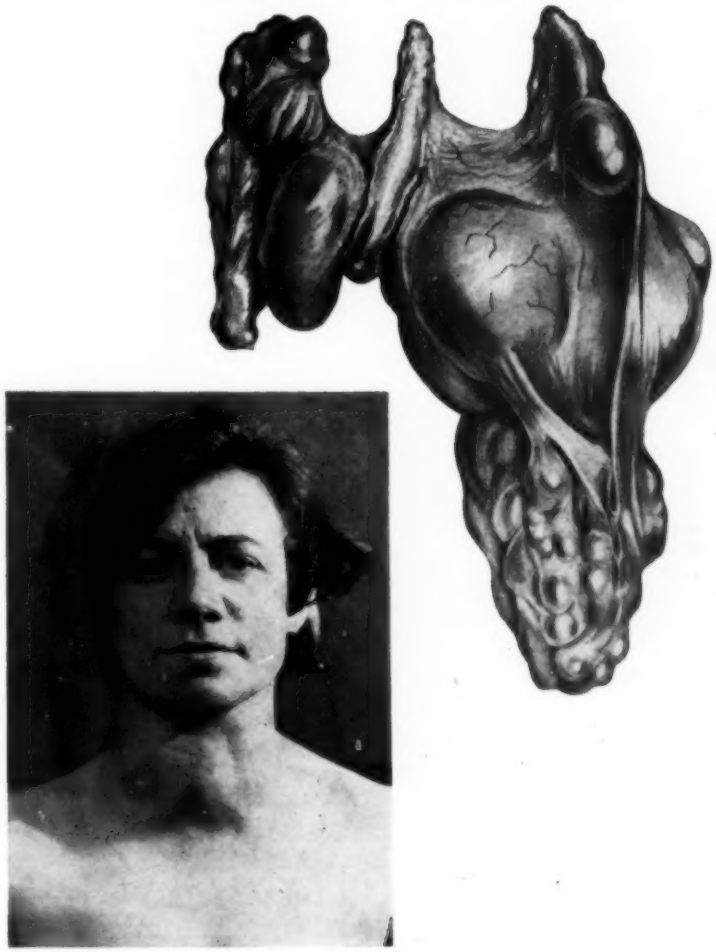


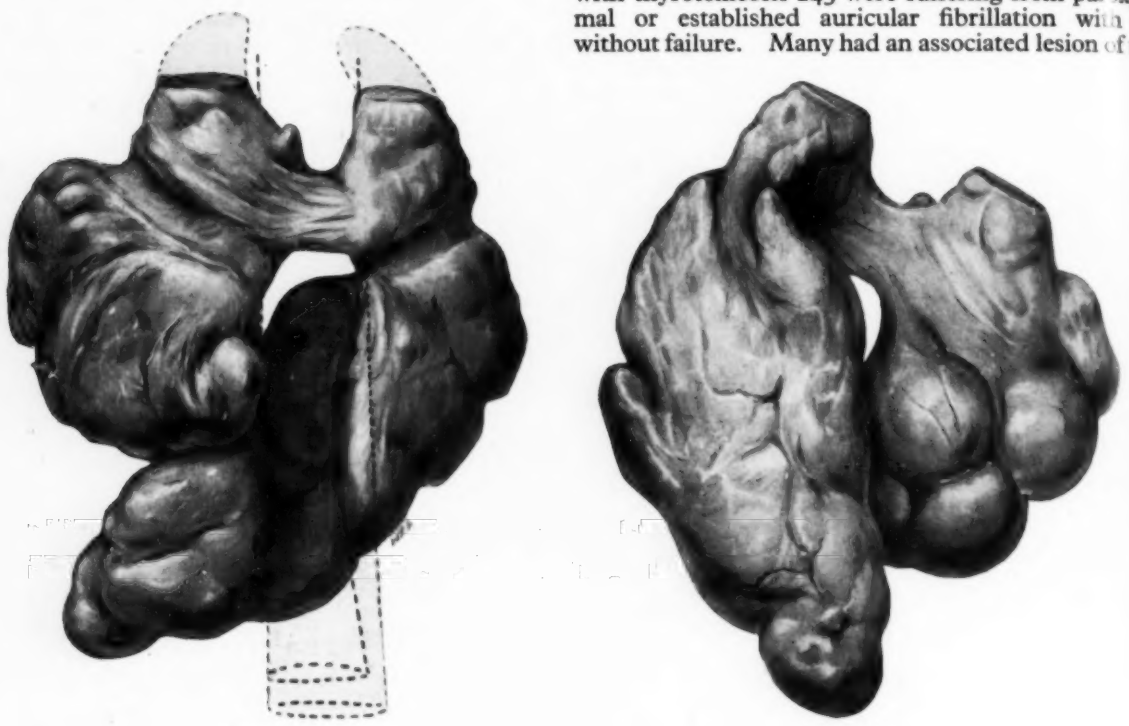
FIG. 523.—Thoracico-cervical goitre. Not infrequently there is 'more' than meets the eye or the fingers.

THE RESULTS OF SURGERY MORTALITY AND MORBIDITY

Non-toxic Goitre.—The relief of venous and tracheal pressure gave a gratifying improvement in the general health of these patients. Many had had a degree of secondary anæmia and clinical symptoms suggestive of a degree of anoxia.

Thyrotoxicosis (*Table III*).—In general, definitive surgery produced very good results. It has to be borne in mind that surgery can only remove the thyrotoxicosis; the unknown factor of causation still remains and is a stimulus to the remnants. The removal of a toxic goitre in a C.3 patient can only leave a euthyroid C.3 patient with a potential risk of recurrent thyrotoxicosis or myxœdema. (*Fig.* 525.)

The Arrhythmias (*Table III*).—Of 1147 patients with thyrotoxicosis 243 were suffering from paroxysmal or established auricular fibrillation with or without failure. Many had an associated lesion of the cardiovascular system: angina, hypertension, valvular lesions. The male incidence was unusually high, 28·4 per cent. Cardiac failure and paroxysmal



A B

FIG. 524.—Thoracico-cervical non-toxic goitre causing severe dyspnœa on exertion. Note the relation to the œsophagus. A, Anterior aspect; B, Posterior aspect.

Table III.—ARRHYTHMIA AND THYROTOXICOSIS, 1930–1956

The Eye Signs, the Position of the Gland, the Type of Arrhythmia, Mortality, and the Spontaneous Return to Normal Rhythm following Surgery in 243 Cases.

Diffuse Goitre 138 (56·8 per cent). Nodular Goitre 105 (43·2 per cent)
Average age, 48·5 years. Males 28·4 per cent

TYPE	EYE SIGNS				POSITION OF GLAND				TYPE OF ARRHYTHMIA				TOTAL	PERCENTAGE
	Ex. Major	Ex. Mod.	Ex. Minor	Stare	C	C/T	C = T	T/C	Par. A.F.	Est. A.F.	Est. A.F. Failure	Est. A.F. Gross Failure		
Diffuse goitre 138	11	59	37	31	128	8	2	—	25	58	47	8	138	56·8
Spontaneous normal rhythm	6	39	34	23	95	7	—	—	25	42	28	7	102	73·9
Normal rhythm not known	—	2	1	2	5	—	—	—	—	3	2	—	5	3·6
Mortality	—	4	—	—	4	—	—	—	1	2	1	—	4	2·9
Nodular goitre 105	1	2	20	82	42	35	17	11	34	32	33	6	105	43·2
Spontaneous normal rhythm	—	—	17	61	33	27	11	7	33	22	21	2	78	74·3
Normal rhythm not known	—	—	2	4	5	1	—	—	1	1	4	—	6	5·9
Mortality	—	—	1	2	—	—	—	3	—	2	—	1	3	2·9

auricular fibrillation were eliminated by surgery. Spontaneous normal rhythm was achieved in 73·9 per cent of diffuse goitre and 74·3 per cent of nodular goitre. Many of this latter group were suffering also from marked venous and tracheal pressure. A further 24 patients were submitted to total thyroidectomy for non-thyrogenic heart failure at the request of the cardiologist, some for coronary disease and others for valvular disease and gross failure with digitalis intolerance.

The total known nerve palsies in benign and malignant goitre were 16 (1·1 per cent).

Routine pre- and post-operative laryngoscopy has only been performed in recent years; it is believed that if this had been carried out in every case the incidence of pre- and post-operative nerve palsy might be higher. Deliberate exposure of the recurrent laryngeal nerves has only been performed as a routine in carcinoma of the thyroid in order to remove the lymphatic chain which follows these nerves into the thorax. In spite of certainty that the nerve was not sectioned or unduly stretched, these three palsies developed. Discharged with an intact larynx, one patient developed a palsy three months later.

A B

FIG. 525.—A, H. M., severe thyrotoxicosis at age 19, February, 1931, 6 months post-operatively severe myxœdema. Refused thyroid extract. B, at age 25, August, 1936, 6 years post-operatively. Spontaneous euthyroidism. This case illustrates the persistent stimulus for regeneration and hyperplasia of the remnants.

Mortality.—The mortality of the whole series was 10 (0·7 per cent). The highest and main incidence was in the thyrogenic arrhythmias, 7 patients of 243 (2·9 per cent). Four of these deaths were due to fatal emboli, 1 to a cerebral catastrophe, and 1 to bronchopneumonia. Of the remaining 4, 2 were anæsthetic deaths in the hands of trainee anæsthetists and occurred on the table. There was 1 fatal case of hæmorrhage, and 1 of diabetic coma, both attributable to post-operative mismanagement.

Morbidity.—

Unilateral Nerve Palsy.—There are 30 instances for discussion. Of the 7 pre-operative lesions 4 had been operated upon elsewhere and admitted for recurrence. Three were discovered in routine pre-operative laryngoscopy; the size of the goitre was not the agent and this suggests that recurrent nerve palsy can occur in the same manner as Bell's palsy or phrenic nerve palsy, and may have the same origin and cause. In benign goitre the post-operative nerve palsy was 16, of which 3 were transient and 13 permanent (0·9 per cent).

Of 39 operable carcinoma of the thyroid 4 showed a pre-operative palsy. Of the remaining 35, 3 developed a post-operative paralysis (8·6 per cent) and 1 a temporary paresis with full recovery.

A male was admitted with a very large non-toxic intrathoracic recurrent goitre and gross displacement of the trachea as a consequence of a previous hemithyroidectomy elsewhere. The offending lobe was removed and the opposite side not explored. The patient developed a palsy on this unoperated side. This suggests that the swing back of the trachea towards the middle line caused traction upon the nerve, possibly held in fibrous tissue. My colleague, Cecil Murray, has had a similar experience.

If the total number of known palsies is examined it is found that about half occurred in severe diffuse toxic goitre in rigid unyielding glands and the remainder in non-toxic partial or complete intrathoracic goitres, suggesting that post-operative nerve palsy is more often than not caused by traction rather than actual section.

Tetany.—One patient suffered from permanent tetany (0·07 per cent). Three of the 4 parathyroids in this case were intracapsular. Since 1936 a long lateral thin leaf has been fashioned in the hope of circumventing this incident.

One patient in 1930 was of extreme interest, a male with Riedel's thyroiditis of the left lobe. When it was exposed it was impossible to remove more than part of the left lobe; the right was not attempted. He was treated post-operatively with deep X-ray therapy. Five years later he developed tetany with a blood-calcium of 5 and passed into a hypocalcæmic coma. He has been maintained ever since on thyroid extract, calcium, and vitamin D.

Twenty-four patients showed transient but no permanent tetany, a proportion with no alteration in their serum-calcium, and the others with a drop to 7·5 or 8. The Chovstek test may be present with a normal or sub-normal serum-calcium. The Trousseau sign is also not of certain assistance in minor degrees of calcium insufficiency. As in recurrent nerve palsy, transient tetany occurred in cervical, rigid, hard, vascular, thyrotoxic glands (15) and in 9 intrathoracic goitres, suggesting that traction or manipulation caused a temporary cessation of function with or without an intraglandular hæmorrhage.

FIG. 526.—Mrs. B. G., age 48. 1931. Complete lymphadenoid goitre. Weight of gland = 454 g. Now aged 74. Euthyroid with thyroid extract grains 2½ daily.

LYMPHADENOID GOITRE

Personal interest in lymphadenoid goitre arose in 1931. Mrs. B. G., aged 48, was admitted with urgent stridor and hypothyroidism. There was a large diffuse goitre in the neck which extended into the thorax. According to her doctor there was a past history of chronic thyrotoxicosis. The goitre was removed under local anæsthesia and histology proved this to be a complete lymphadenoid goitre weighing 454 g. The patient has been maintained in normal health on 2½ gr. of thyroid extract.

From that time, based on theoretical grounds, every attempt was made to treat lymphadenoid goitre with thyroid extract in the hope of resting and reducing the gland in size. Some success was achieved, but on the other hand one was never sure of the diagnosis nor of the duration of time to persist with thyroid extract. As a consequence certain cases were operated upon for symptoms and signs of pressure, or for attacks of pain and so-called thyroiditis. These were large diffuse goitres.

A B

FIG. 527.—Mrs. D. G. in 1954, aged 41 years. B, In 1957, aged 44. Lymphadenoid goitre—Hashimoto's syndrome. The clinical diagnosis was confirmed by modern methods. Treatment by thyroid extract only.

Sixteen patients, 1·1 per cent of all thyroidectomies, and 4·3 per cent of non-toxic goitres of all types and 20 per cent of all non-toxic diffuse goitres, were operated upon for complete fibro-lymphadenoid goitre. In 10 further cases there was a severe but not total degree of lymphadenoid replacement. Three were non-toxic goitres, but 7 had infiltration. No doubt in time our pathologists will be able to give more exact details and valuable help. The collaborators in this Clinic have shown first the utility of the gamma-globulin and flocculation tests, the value of the preceptin test, and the extreme value of the radioactive iodine topography and function of the gland. Diagnosis can now be

Table IV.—A Comparison of an American and a Personal English Series

	Carcinoma	Total Cases	Non-toxic Nodular Goitre	Toxic Nodular Goitre	Solitary Nodule	Diffuse Toxic Goitre	Thyroiditis	All Nodular Goitre
								Non-toxic = 644 Adenoma = 104 Toxic = 113
* Cattell and Colcock: 1951 to 1952 (2 years)	78	1479	644 + 104	113	156	447	93	861
Females = 57	Carcinoma	78	76	2	52	0	0	78
Males = 21 (26·9 per cent)	per cent	5·3	10·2	1·6	33·3	0	0	9·1
							Lymph-adenoid Goitre	Non-toxic = 329 Single Nodule = 52 Toxic = 436
Personal Series: 1930 to 1956 (26 years)	39	1518	329	436	52	711	16	817
Females = 34	Carcinoma	39	33	5	2	1	0	38
Males = 5 (12·8 per cent)	per cent	2·6	10·0	1·0	3·8	0·18	0	4·7

* *J. clin. Endocrin.*, Nov., 1953, **13**, No. 11.

Table V.—The Single Nodule

(52 Cases (6·8 per cent of Non-toxic Nodular Goitre). Males 17·3 per cent. Average age 41 years.)

Type of Nodule	Number	Goitre		Benign Adenoma	Colloid Nodule	Degenerating Colloid Nodule	Cysts	Fœtal Adenoma	Papillary Cyst Adenoma	Hurthle Celled Benign	Per cent Pre-carcinoma	Carcinoma	Per cent Carcinoma
		Diffuse	Nodular										
True Single	7	—	—	—	—	—	—	3	2	1	28·6	1	14·3
True Single and Goitre	38	38	—	7	11	6	12	1	—	—	2·6	1	5·3
Apparent Single Nodule	7	—	7	—	—	6	—	1	—	—	—	—	—
Total	52	38	7	7	11	12	12	5	2	1	5·8	2	3·8

positive and definite evidence of thyrotoxicosis, with typical eye signs. A number of patients have responded well to thyroid extract and have not needed surgery. In 1 patient with a lymphadenoid goitre and marked thyrotoxicosis it was possible to follow the spontaneous change to euthyroidism and eventually marked myxœdema. There is no doubt that a proportion of lymphadenoid goitres, but by no means all, are preceded by a thyrotoxic goitre.

Beare and Drew Thomson (awaiting publication) have found a lymphadenoid goitre which was accompanied by a carcinomatous area. Other cases have been recorded. The diagnosis of lymphadenoid goitre, therefore, does not absolutely exclude a carcinoma.

There is an urgent need for the definition of this disease. On clinical grounds the classification used at present is: (1) fibrolymphadenoid and complete lymphadenoid goitre (Hashimoto's disease); (2) (*a*) severe, (*b*) moderate, (*c*) mild lymphadenoid made with certainty in complete fibro- or lymphadenoid goitre. We are agreed that a more sensitive test, the complement-fixation test, would be of extreme value, for this would enable detection of the early lymphadenoid change and eliminate the necessity for surgery in certain cases of toxic and non-toxic goitre. (*Fig.* 527.)

Thyroiditis.—Two cases were diagnosed by the pathologist as Riedel's thyroiditis, a male and a female, an incidence of 0·1 per cent. Both are euthyroid with the assistance of thyroid extract.

CARCINOMA OF THE THYROID GLAND (39 Cases) AND THE SINGLE NODULE (52 Cases)

Thirty-nine patients (2·6 per cent of all thyroidectomies) proved operable and the gland was graded histologically: 33 were non-toxic (8·9 per cent of all non-toxic goitres), and 6 were toxic goitres (0·8

Table VI.—Carcinoma of the Thyroid

Histological Type, Size, Additional Treatment, and Results in 39 Cases, 1930–1956. Males 12·8 per cent.

Type	Number of Cases	X rays + Surgery	Diffuse Goitre	Non-toxic Nodular Goitre	Toxic Nodular Goitre	Size of Gland			Average Age	Age Range	A = Survivors, and D = Deaths from Cancer in Years											
						Small	Mod.	Large			20		15		10		5		2		1	
											A	D	A	D	A	D	A	D	A	D	A	D
Papillary Cyst Adeno (Aberrant 7)	14	5	4	8	2	9	4	1	48	28–78	1	2*	3	0	4	0	11	0	12	0	13	1
Adenocarcinoma (Aberrant 3)	11	4	1	8	2	5	2	4	47	23–69	0	0	0	1	1	0	3	1	7	2	10	1
Spheroidal-celled (Aberrant 1)	6	4	0	5	1	1	3	2	57	48–75	1	0	2	0	2	0	2	0	3	1	4	2
Undifferentiated (Aberrant 0)	8	6	0	8	0	1	0	7	56	32–76	0	0	0	0	1	0	2	0	4	4	8	0
(Aberrant 11) *Total*	39	19	5	29	5	16	9	14	52	23–78	2	2	5	1	8	0	18	1	26	7	35	4

* One recurrence free killed in an accident.

per cent of all toxic goitres). One only was diffuse (0·2 per cent), suffered severe thyrotoxicosis, and had had seven years' antithyroid drug therapy. Five were multinodular toxic goitres, 1 with severe thyrotoxicosis and arrhythmia, and 4 with mild thyrotoxicosis. Twelve patients were sent direct to the Clinic because of the personal interest in carcinoma of the thyroid. Twenty-seven were discovered or suspected in the routine examination of all cases of goitre sent for diagnosis, an estimate of 0·5 per cent.

A comparison of a series from the United States and this personal series has been made (*Table IV*). The essential difference is in the incidence of carcinoma in the single nodule (3·8 per cent in this series as compared with 33 per cent in the Boston Clinic).

The Single Nodule.—A true single nodule is very rare but dangerous; it consists of a single nodule occupying one lobe with a thin capsule of surrounding normal thyroid tissue; the opposite lobe is normal and there is no goitre. Potential or actual precarcinomatous lesions, 3, and 1 carcinoma (57·1 per cent). In 45 there was a small goitre clinically diffuse, but in 7 proved to be nodular; the multinodular elements failed to deform the surface of the gland and betray their presence to the clinician (*Table V*). One was a benign fœtal adenoma and 6 colloid or degenerating colloid nodules. In 38 the gland was diffusely enlarged, but to a small degree. In 36 of these the nodule was either a simple adenoma, or a colloid nodule with or without degeneration, but in 2 one was a precarcinomatous fœtal adenoma and the other a very small calcified adenocarcinoma. In the 52 cases, therefore, there are 2 carcinomas (3·8 per cent) and 3 true precarcinomatous lesions, a total of carcinoma or precarcinoma of 9·4 per cent.

The evidence points conclusively to the fact that a carcinoma or a benign tumour which may or may not be precarcinomatous can arise in a normal thyroid gland or in a small diffuse goitre. This suggests that a carcinoma in a multinodular goitre can arise in the internodal tissue and not necessarily in one of the nodules of the multinodular goitre.

Recurrent Goitre.—In 7 cases, 3 papillary cyst adenocarcinomas, 2 adenocarcinomas, and 2 undifferentiated carcinomas, the lesion was a recurrence following a partial thyroidectomy elsewhere for an apparent benign goitre. In 4 the recurrence was long in making its appearance, in 2 cases of adenocarcinoma 19 years and 10 years, and in 2 cases of undifferentiated carcinoma 20 years and 11 years. It is possible in some of these cases that at the original operation the gland was malignant, but in 3 the evidence suggests that the carcinoma developed in the remnant, for this remnant was the complete lobe which had been left behind in the hemithyroidectomized patient.

Table VI is self-explanatory and is an analysis of the 39 cases and their follow-up.

Keynes has pointed out the astonishing variety which occurs in thyroid carcinoma. Classification of this disease is of the greatest difficulty, susceptibility to treatment varies within wide limits, and diagnosis in certain cases is virtually impossible.

So-called Aberrant Goitre.—No less than 11 presented as a tumour of one or other

Table VII.—An Analysis of the Eye Signs in 1147 Cases of Thyrotoxicosis, and of the Complications in 29 Patients

	Sex			Eye Signs						Onset in 29 Patients		Adjunct to Surgery		Progressive Exophthalmos 19 (Instances)				Ophthalmoplegia 20 (Instances)	
	Males	Females	Males and Females	Uni. Ex.	Sym. Ex.	Ex. Maior	Ex. Mod.	Ex. Minor	Stare	pre-op.	Post-op. No Remission	Tars.	X rays to Orbits	Recovery	Imp.	I.S.Q.	Failed	Recovery	Failed
All cases of thyrotoxicosis 1147	186	961	1147	32	466	201	297	142	507										
Prog. exophthalmos only 9	4	5	9	4	5	7	2	0	0	9	0	0	3	5	2	2	0	0	0
Prog. exophthalmos and ophthalmoplegia 10	4	6	10	6	4	6	4	0	0	10	5	5	5	6	0	2	2	6	4
Ophthalmoplegia without prog. exophthalmos 10	8	2	10	3	7	3	5	0	2	10	0	0	1	0	0	0	0	4	6
Total	16	13	29	13	16	16	11	0	2	29	5	5	9	11	2	4	2	10	10

jugulodigastric lymphatic glands, 7 papillary cyst adenomas, 3 adenocarcinomas, and 1 spheroidal-celled carcinoma. Two, both adenocarcinomas, presented because of the secondary metastasis in bone.

The size of the primary varied from an impalpable pea to a large, diffusely infiltrated goitre. In 16 the goitre was small, averaging 37 g.; in 9, of moderate size, averaging 60 g.; and in 14, large, weighing over 200 g. No matter what the size of the gland the undifferentiated carcinoma was the most malignant; adenocarcinoma was highly malignant also, irrespective of the size of the gland; spheroidal-celled carcinoma, if in a small gland and encapsulated, gave a reasonable prognosis, but if accompanied by a large gland was highly malignant. Papillary adenocarcinoma, as stated by many authors, showed a better prognosis. Extreme emphasis must be placed upon the fact that this condition is malignant and must be treated as such from the outset in order to obtain the best results in this more favourable type. The greatest harm has been done by advocates of minor surgery in this malignant condition.

X-ray Therapy.—It is extremely difficult to estimate the value of surgery alone or pre- and post-operative X-ray therapy. Nineteen of these patients had X-ray therapy in addition to surgery. Post-operative X-ray therapy following a block dissection and total thyroidectomy gives rise to great discomfort and in some to intractable causalgia. It is felt that routine post-operative X-ray therapy should not be employed but only used for some very definite reason.

Heroic surgery in large malignant goitres, including partial pharyngectomy, although achieved without mortality or morbidity, and immediately followed by X-ray therapy, has so far given extremely disappointing results.

THE EYE SIGNS IN THYROTOXICOSIS

In 1147 patients with thyrotoxicosis and 'basal' eye signs 498 had the additional sign of exophthalmos, 201 with exophthalmos of major and 297 with exophthalmos of moderate degree—66·3 per cent in diffuse goitre and 14·9 per cent in nodular goitre. In the latter the anodular tissue was abundant and the nodules few. Unilateral exophthalmos formed 6·4 per cent (*Table VII*).

All with exophthalmos major and some with exophthalmos of moderate degree had a threat of so-called 'progressive exophthalmos'.

In 29 patients the eye signs present gave rise to great concern regarding the prognosis and fate of the eye, in 20 instances due to pre-operative ophthalmoplegia and in 19 to a marked pre-operative threat of progressive exophthalmos.

As a result of the definitive control of the thyrotoxicosis 50 per cent of those with ophthalmoplegia and a partial paresis recovered spontaneously, 50 per cent with marked paresis failed to recover.

In so-called progressive exophthalmos 6 recovered and 1 improved spontaneously, and a further 5 recovered and 1 improved as a result of adjunctive treatment with tarsorrhaphy and X-ray therapy to the orbits.

Remission, which was either complete or partial, therefore occurred in over 99 per cent of all cases of exophthalmos.

Two absolute failures of remission occurred: one, a male who had returned to Ceylon, developed two years post-operatively an infection in one eye, which had to be enucleated; the second, a female, developed thirteen years post-operatively terminal cardiac failure and this was accompanied by worsening of the exophthalmos but without loss of sight.

In 4 the remission has not been sufficient to consider that the eyes are permanently out of danger; all are males, and 2 of them have persistence of their ophthalmoplegia.

It so happened that 5 patients, 1 male failure and 2 of the four males in the incomplete remission group, had had more than two years' pre-operative antithyroid drug therapy, the male who lost his eye, for no less than five years.

Ophthalmoplegia was not dependent upon the degree of exophthalmos; exophthalmos major in 9, moderate in 9, and in 2 there was no exophthalmos.

A marked feature of these 29 patients with complications was the high incidence of the male, and the high incidence of unilateral exophthalmos. Unilateral exophthalmos was present in 13 and formed 44·8 per cent of all cases of unilateral exophthalmos. In all cases of thyrotoxicosis the male formed 16·2 per cent; in exophthalmos, however, 53·8 per cent, and in those with complications 55·2 per cent. This shows an incidence of 14·9 per cent of all males with thyrotoxicosis, as opposed to 3 per cent of all females. The male is undoubtedly more prone to exophthalmos and its complications than the female.

Age *per se* was not the cause of ophthalmoplegia or so-called progressive exophthalmos. In ophthalmoplegia the average age was 51·8 years and in so-called progressive exophthalmos 45·4 years, with an age range of 24–68 years.

It would appear that the definitive control of thyrotoxicosis can engender resolution of the periorbital and orbital tissue. This suggests that the control of the abnormal vascularity, and restoration to normal of an impeded venous drainage, restores also to normal the metabolism of the intra-orbital structures.

The duration of time of remission is variable and dependent upon the severity and duration of the thyrotoxic intra-orbital metabolic change. In some the extensive damage may be irreversible.

Myxœdema, if present, must be controlled by the dose requisite for the particular individual; incorrect dosage can retard or prevent remission of the eye signs and encourage reactivity of the thyroid remnants.

As to causation, an independent exophthalmic factor cannot be excluded; if it was present it was part of the thyrotoxic syndrome and governed by an anti-exophthalmic factor.

It is believed that in any stage of thyrotoxic exophthalmos the correct treatment is to render the patient euthyroid by definitive treatment to the thyroid gland. The condition of the eye can then be accurately assessed and appropriate adjunctive treatment be given to the eyes should it still be found necessary.

ANTITHYROID DRUGS

Neo-Mercazole.—In the past five years 176 patients have been treated in my Out-patients with Neo-Mercazole by Dr. Doniach. The results from 1952–6 (four years) are as follows: 158 patients treated—50·6 per cent in apparent cure on completion of treatment; 18·4 per cent still under treatment; eventually treated by surgery 27·2 per cent. The toxic reactions have been 2·5 per cent, drug rashes or intolerance, all in a group of proven allergics.

Neo-Mercazole is a valuable drug. The faults in treatment with antithyroid drugs are overdosage, with a goitrogenic effect, and persistence with the drug when too high a maintenance dose proves necessary. Unless the patient can be maintained euthyroid on a very small maintenance dose results are most unsatisfactory. The main danger is the worsening of exophthalmos in the exophthalmic patient.

Thyroid Extract.—The use of thyroid extract as the medical treatment of non-toxic diffuse or nodular goitre is still uncertain. It appears safe if small doses are used, but can be dangerous with overdosage. It has been disappointing in the majority of cases of non-toxic nodular goitres. It has been of extreme value in controlling and reducing the size of the remnant in patients who have had a post-operative recurrence in a non-toxic remnant.

It is of the utmost importance to be able to recognize the early signs of not only covert recurrent thyrotoxicosis but also subclinical myxœdema, and many patients post-operatively need temporary assistance with thyroid extract. The B.M.R. may be misleading. The earliest change is found in the fat and subcutaneous tissue over the deltoid muscle and erector spinæ group. The patient lacks energy, does not feel well, has a feeling of stiffness, and is unhappy and depressed.

Overdosage with thyroid extract is to be deplored; it appears to encourage exophthalmos and hyperplasia of the remnants in toxic goitre. The necessary dosage varies considerably from patient to patient: complete myxœdema may be corrected with 2–2½ gr. of thyroid extract a day, but some may require 5 gr. or as much as 7 gr. a day. It is advisable to start with a low dosage and work up to the necessary amount. We have records of patients who undoubtedly developed thyrotoxicosis and some with arrhythmia because they had been taking, or had been given, large doses of thyroid extract for slimming or amenorrhœa.

Thyroid addiction is rare. It has been seen in two female patients. In one the patient was taking 70 gr. of thyroid extract a day. There appeared to be no clinical evidence of overdosage. The second was a secret addict in order to produce ill health; her signs and symptoms were those of parathyrotoxicosis (neuro-circulatory asthenia, autonomic imbalance). A biopsy of the gland in this case showed normal thyroid tissue.

Iodine.—Iodine has been disappointing and virtually useless in the treatment of non-toxic sporadic goitre, and this fact has been emphasized by previous writers. Its supreme use is for the temporary measure of control of thyrotoxicosis for the purpose of surgery, and the control of thyroid crisis in those admitted with an iodine-free gland. In the early days of this work cases of jodbasedow were witnessed, and occasionally are still seen.

COMMENTARY

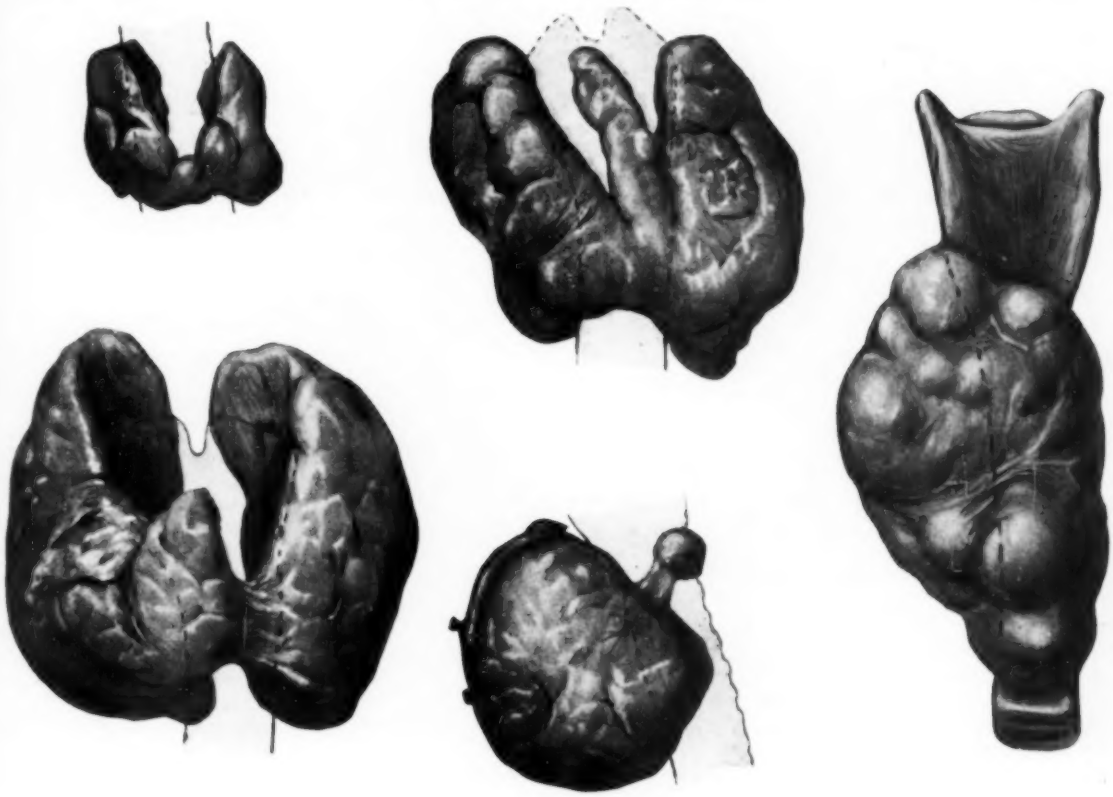
Economy of words has been essential and much of the evidence has had to be given in the form of tables. No word and no statistical table can express the fact that each patient is an individual and each in turn shows a subtle and different biological response to goitre and its complications.

Thyrotoxicosis is a tragedy altering the constitution of the afflicted, and in particular the personality, exaggerating the faults and submerging the virtues. It is a cruel disease and in some a crude disfiguring agent. In my experience it particularly afflicts the over-conscientious, who thus live in enhanced and mortal dread of the unknown and crave security. Apparent cowards, it is the disease which has rendered them so, for in fact their physical bravery when called upon is of the highest order.

The Effect of the Pituitary Thyrotropic Hormone (T.S.H.).—Certain cases of non-toxic and toxic goitre appear to the clinician to be under the influence of T.S.H. On the other hand many non-toxic goitres do not appear to be stimulated or controlled by this agent. The apparent autonomy of these non-T.S.H. glands defy medical treatment, and eventually surgery has to be performed for pressure symptoms and signs and the associated ill health.

Exophthalmos.—The high incidence of toxic goitre without exophthalmos may imply that these goitres are also relatively autonomous and not directly under the influence of T.S.H. or that they are originally non-T.S.H. diffuse or nodular goitres which have in some way altered the constitution of the host prior to becoming toxic.

Toxic Diffuse and Toxic Nodular Goitre.—If the eye sign exophthalmos is excluded, there are 'basal' eye signs common to all diffuse and nodular goitres: 'Stare', widening of the palpebral fissure, and a varying degree of lid retraction and 'lid lag'.



A B C

FIG. 528.—A, Although all these goitres were associated with arrhythmia, they equally well represent the size of toxic goitres and normal rhythm. B, Toxic goitre. Auricular fibrillation. C, Hemithyroidectomy elsewhere. Toxic nodular goitre. Auricular fibrillation.

The symptoms and signs, the complications, the response to known methods of treatment are the same, differing only in degree.

The non-functioning and degenerative nodules can only be successfully dealt with by surgery, but can diminish in size with alternative methods of treatment, probably owing to the alteration in their blood-supply.

The size of the goitre bears no relation to the degree of thyrotoxicosis or the onset of arrhythmia (*Fig.* 528). It appears to be the quality and not quantity of the toxic diffuse anodular tissue and the severity of the unknown stimulus and not the quantity of goitrous tissue that matters.

As a clinician one must reach the conclusion that the operative cause of toxic goitre is the same for diffuse and nodular goitre. On the other hand some diffuse and the majority of multinodular goitres have in some way developed more resistance to this agent, and in particular to exophthalmos. To the clinician the evidence suggests that the

disease is due to excess of secretion rather than dysthyroidism.

The histories of some patients suggest that the demand for excess secretion originates in the target cells, and that this abnormal craving insists upon an excess production of thyroid secretion.

Both non-toxic and toxic goitre show a strong familial tendency according to our records. Very rarely can one obtain suggestive evidence that the thyroid gland is normal and stable prior to the onset of thyrotoxicosis. The clinical evidence is that in the great majority either a diffuse or, because of the duration of the goitre, a nodular goitre has been present for a varying length of time, and upon these goitres is engrafted the condition we recognize as thyrotoxicosis. In fact the majority of our cases appear to be secondary diffuse or secondary nodular goitres. Whatever the agent may be which produces the derangement of the gland and thyrotoxicosis it is a goitrogenic agent, and this influence may be enhanced by overdosage with antithyroid drugs.

In this respect in the old days of iodine therapy the goitrogenic result was the same as that produced by modern antithyroid drugs—an increase in size of the goitre, intense vascularity, and a rigid unyielding goitre.

To the clinician, therefore, there would appear to be a stable thyroid gland unaffected by war or peace, untouched by tragedy or ill health, catastrophe or success; puberty, marriage, child-bearing, and the menopause; the goitrogenic excess of iodine or thyroid extract.

There is described a physiological enlargement of the thyroid gland. Our records show that undue so-called physiological enlargement of the thyroid gland preceded the goitre and its complications.

A goitre, however small, may be a harbinger of the future. Thyrotoxicosis is a deplorable disease if permitted to persist—the personality, the judgement, the physical state, and appearance may never completely recover. The stigma and the possibility of recurrence remain.

Subclinical chronic and persistent thyrotoxicosis is not uncommon either in the untreated or in cases due to failure of definitive medical or surgical treatment. Paroxysmal and finally established arrhythmia is the fate of many of these patients. Recurrent thyrotoxicosis is one of the most difficult diseases to treat and cure.

It is the aim of all of us to produce a permanent state of euthyroidism. Myxœdema, although not desirable, can be readily remedied by the intelligent use of thyroid extract. Myxœdema as a consequence of definitive treatment is preferable to the recurrence of non-toxic and the tragic recurrence of toxic goitre.

Goitre is a national problem. It is a common disease among the inhabitants of the British Isles. This work is a statement of fact regarding the complications of goitre; it does not include the many who have learnt to live with their goitre and may or may not seek advice in the future.

The Roman learnt to remove his Legion from endemic goitre areas within two years in order to prevent goitre, only to find that the majority of incipient goitres disappeared in course of time. In Rome the thyrotoxic slave was sold cheaply, for the Slave Market recognized that he was incapable of hard or prolonged effort. The Roman matron measured the neck of her prospective daughter-in-law with deep suspicion.

It would appear that increased efforts should be made to prevent goitre and thus prevent the complications, the ill health, and the tragedies experienced by the goitrous.

It is impossible to thank by name the great many in the Laboratories, the Wards, and the Out-patients departments who have assisted in this work at the Middlesex Hospital. My thanks are also due to the Connaught Hospital and the Italian Hospital.

Professor Sir Charles Dodds and Dr. Douglas Robertson made possible the safe surgery of thyrotoxicosis; Dr. Evan Bedford has rendered invaluable assistance in the surgery of the arrhythmias; Bernard Johnson, F.R.C.S., perfected the technique of safe anæsthesia; Miss Dorothy L. Thomas, *G.C.*, virtually eliminated theatre sepsis; Miss Fletcher and her nurses gave their care for so many patients.

In the more recent years particularly are my thanks due to Dr. Deborah Doniach, Dr. Roitt, Dr. Ken Jones, Dr. Drew Thomson, and Mr. Charles Rose whose teamwork solved the mystery of Hashimoto's disease and established the significance of Hashimoto's fundamental observations.

To the many authors of valuable papers much is due, but in particular to Sir James Berry and Sir Thomas Dunhill, of England; Dr. W. S. Halsted, Dr. H. S. Plummer, and Dr. André Crotti, of the United States of America. For the faithful keeping of records I am greatly indebted to my secretary, Mrs. G. Gundry.

The beautiful drawings are by the master hand of W. Thornton Shiells.

I am also in debt to the Photographic Department of the Middlesex Hospital for some of the photographs.

TOTAL THYROIDECTOMY

By E. D. AHERN

PAST PRESIDENT, ROYAL AUSTRALIAN COLLEGE OF SURGEONS

To be regarded as a friend of Gordon Gordon-Taylor is a great honour. To contribute a short article to the BRITISH JOURNAL OF SURGERY commemorating this twentieth-century master surgeon's eightieth birthday is an added pleasure.

Sir Gordon Gordon-Taylor's work and teaching have been highlighted by a radical and thorough attack on disease.

Under the circumstances I thought an appeal for complete as against subtotal thyroidectomy would be following in his footsteps at a respectable and respectful distance.

FIG. 529.

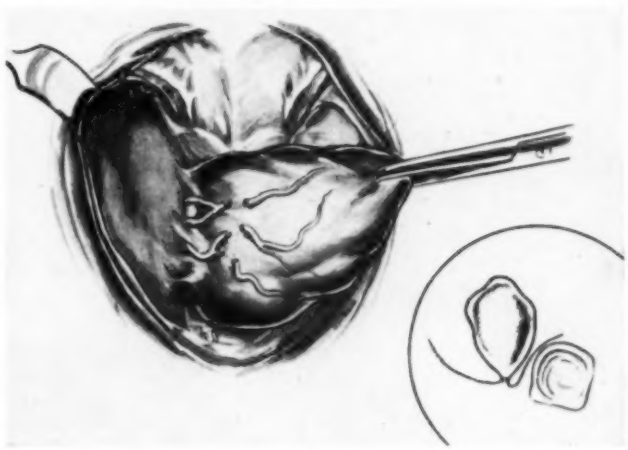


FIG. 530.

It is suggested that complete thyroidectomy is most likely to give the best immediate and remote results and this is especially true in cases of cardiac disability due to thyrotoxicosis. At least that has been my experience, and not only with my own cases.

To leave a layer of tissue at the side of the trachea too often means a mild thyrotoxicosis with a pulse rate of 85–90 and a mild degree of anxiety associated with variable degrees of hypothyroidism.

This is a condition which is difficult to rectify by the use of thyroid gland, as the toxic element makes it difficult and sometimes impossible to apply successfully. Furthermore, the tissue remaining is frequently, though not always, liable under the demand for thyroxin to enlarge and become toxic, sometimes to an alarming degree.

Total thyroidectomy does not carry the risk of later morbidity, but is rather more difficult to perform and so has not been as popular as it might otherwise have been.

The only difficulty in post-operative treatment is to find the correct dose of thyroid gland which varies for these cases, 1 gr.–3 gr. daily in this area.

The operation suggested is done without section of the strap muscles—with rare exceptions—and is an intrafascial dissection in which the capsule of the gland is cleanly separated by gloved finger and dry gauze from the fascial envelope of the pretracheal fascia. The incision is placed rather high so that access to the upper pole is made easier. The skin and platysma are divided down to the deep fascia, which in turn is divided between the two sternohyoid muscles. Separation of these muscles displays the sternothyroid muscles. When these muscles are separated by division of the intervening fascia the operator is then working in the pretracheal fascial pouch surrounding the thyroid gland (*Fig.* 529).

This fascial covering must be separated cleanly from the capsule of the gland by glove and gauze dissection. By cleaning the anterior surface of the left lobe first and then the right the fascial reflection from the thyroid cartilage can be demonstrated and tied off (*Fig.* 529). The communicating vessels from the cricothyroid muscle to the thyroid are then tied off in continuity and cut between the ligatures.

Traction on the gland with gland-holding forceps or a heavy catgut suture displays the medial aspect of the upper pole. The two arteries, the anterior and lateral branches of the superior thyroid artery, are then divided between ligatures (*Fig.* 529).

The superior pole freed in this manner comes down into the wound and allows easy division between ligatures—close to the gland—of the remaining blood-supply. This method is safer and easier to perform than attempting to tie the upper pole in one ligature, and furthermore protects the external laryngeal nerve from injury.

Finger and dry gauze dissection of the right lobe from the fascial envelope on the external surface displays the middle thyroid veins (*Fig.* 530) which when tied and divided between ligatures give deeper and better access to the lower pole, which is dissected by brushing down the fascia and ligating in continuity the inferior thyroid artery and veins—close to the gland—and dividing between ligatures.

The caudal border of the isthmus is cleaned in the same way and the isthmus lifted from the trachea by forceps or blunt dissector in what is a natural plane of cleavage (*Fig.* 529). Section of

the isthmus at this stage gives access to the postero-medial surface of the gland.

The clear illustrations by Miss Lindsey Pegus, Medical Artist of the Medical School (University of Queensland), show quite clearly the next steps and the object of the manœuvres, i.e., separation of the gland from its fascial envelope to a band of tissue on the postero-medial aspect of the gland—entirely

FIG. 531.

within the fascial envelope (*Figs.* 530 inset, 531, and 532).

During this manœuvre the suspensory ligament of Berry is tied off close to the gland—an essential step. Careful dissection and squeezing between thumb and finger readily give the desired result and the gland is clamped along the postero-medial edge just taking in the fascial reflection (*Figs.* 530, inset, and 532).

The fine curved artery forceps should be applied close to and including a thin wedge of gland. The amount of gland and fascia grasped should not be more than $\frac{3}{16}$ in. so that the tissue can be tied off without risk of slipping (*Fig.* 532).

The harder the tissue the smaller the bite. The tissue caught in each forceps is cut with a little free tissue and the gland is not severed right to the tip of the forceps (as in kidney pedicle technique).

Four to six forceps should clear the gland, which is then removed. The forceps are then ligated with fine catgut, leaving a line of ligatures and an unbroken fascia.

With care no damage should be done to the recurrent laryngeal nerve, and if all ligatures are placed right against the gland capsule no harm should be caused to the parathyroid glands, which always can be seen.

The skin is closed with Michel clips. No suture is placed in the subcutaneous fascia and platysma. Wounds are undoubtedly better without it. Drainage is a matter of choice—I always drain.

Points in Technique.—

a. When the neck is extended do not have the strap muscles too tight. Too much tension only adds to the difficulties.

b. Adopt the principle of ligature in continuity where possible—it eventually saves time and is safer. If instead of using artery forceps on the gland side ligatures are used, the wound is clear and unobstructed.

c. If bleeding should occur always search for the offending artery with dressing forceps and define and see it before applying crushing artery forceps.

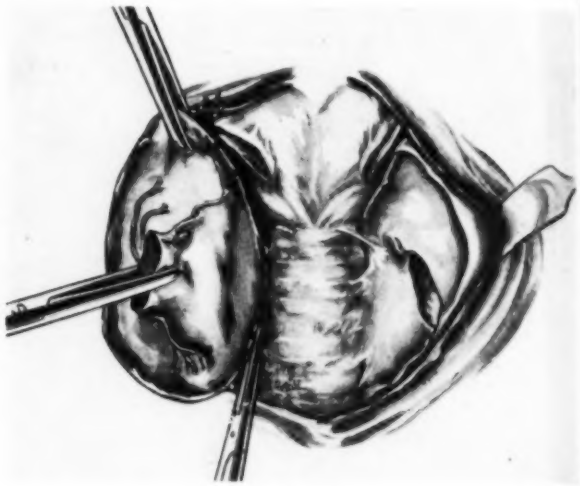


FIG. 532.

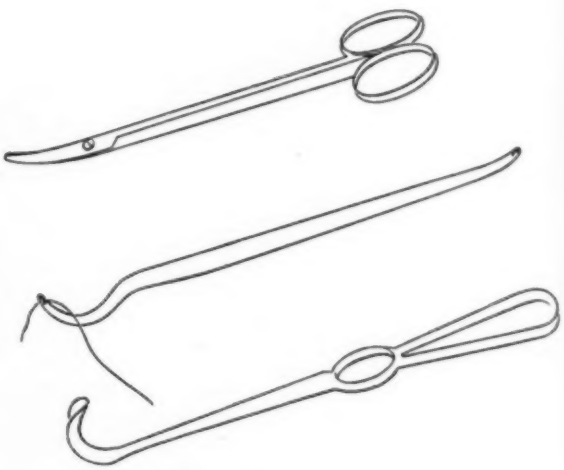


FIG. 533.

d. The instruments depicted by the artist in *Fig.* 533 are a great help: (i) Devine scissors; (ii) MacCormick dissector; (iii) A small curved retractor for use around the upper pole.

Three dissectors are used—two loaded. Note the ligature is passed from the inside of the curve through the eye and only threaded some 4 in.

When picked up by dissecting forceps after being placed in position the ligature comes clear of the dissection easily and quickly.

Acknowledgements.—In the preparation of this paper I am indebted to the Dean of the Faculty of Medicine, University of Queensland, Prof. N. Sutton, to L. I. McGuire, Director of Postgraduate Studies, to Miss L. Pegus, Medical Artist, and to Miss M. Waugh, Librarian.

THE TREATMENT OF PAROTID TUMOURS IN THE LIGHT OF A PATHOLOGICAL STUDY OF PAROTIDECTOMY MATERIAL

By DAVID H. PATEY and A. C. THACKRAY

FROM THE DEPARTMENT OF SURGICAL STUDIES AND THE BLAND-SUTTON INSTITUTE OF PATHOLOGY, MIDDLESEX HOSPITAL

The development and standardization of the technique of parotidectomy with preservation of the facial nerve have in recent decades revolutionized the surgery of the parotid. Apart from the greater freedom that the command of the readily acquired technique gives to the surgeon in dealing with parotid disease, the material that he obtains is much more valuable for pathological study than the very limited material available when he was inhibited by exaggerated fear of the facial nerve.

Since January, 1952, we have adopted the routine policy of early exploration of parotid tumours with a view to parotidectomy. This article reports the results of the pathological study of the 80 specimens obtained up to the end of August, 1957. We find it a happy coincidence that 80 represents also the age of the ever youthful teacher, colleague, and friend in whose honour the present number of the JOURNAL has been written. Four cases of cysts have been included, but no cases of tumour-simulating inflammatory lesions. Two of the specimens, both adenolymphomata, came from opposite parotid glands of the same patient. For the purpose of the analysis we have counted them as separate. During this time 6 cases referred for treatment were not operated on. One was an acute ulcerating carcinoma; another a recurrent mixed tumour with spread to the base of the skull; another a recurrent mixed tumour that refused operation; another was probably carcinoma of the parotid with, in addition, carcinoma of the breast and cardiac failure. The fifth was a second patient with bilateral tumours, who, after a successful parotidectomy for an adenolymphoma of one side, was unable to have the operation on the other side owing to the development of pulmonary tuberculosis. The sixth was a hæmangioma that has already been reported in another connexion (Patey and Thackray, 1956). With these exceptions, all cases of parotid tumour referred to us during the period under review were operated on.

Operations Performed.—The standard operation was conservative parotidectomy, i.e., parotidectomy with conservation of the facial nerve. This was carried out in 68 of the 80 cases. In 6 of these the parotidectomy was partial, in 38 superfacial, and in 24 total. In 3 of the total conservative parotidectomies, although the whole facial nerve was conserved, extensive resection of invaded adjacent muscles was necessary, the masseter in 2 cases and the sternomastoid in 1 case.

In 4 further cases conservation of the facial nerve was only partial, one of the two main divisions being preserved and the other sacrificed because of invasion by tumour; in 3 of these the upper division was sacrificed and in the fourth the lower.

In 7 cases radical parotidectomy was carried out, i.e., with complete sacrifice of the facial nerve. The remaining case required skin excision only for recurrence limited to the scar. Of the 7 radical parotidectomies, 4 were performed for carcinoma, 1 for lymphoblastic sarcoma, and 1 for a diffuse recurrent mixed tumour. The seventh case was a primary mixed tumour associated with chronic sialectatic parotitis, and also with marked secondary parotitis from an excessive injection of radio-opaque oily medium during sialography. This case has already been reported in detail elsewhere (Thackray, 1955). The combination of pathological conditions together with the diffuse greasy character of the gland from extravasation of the oily medium rendered preservation of the nerve branches so abnormally difficult that the attempt was eventually abandoned. This was the only case in the series in which the facial nerve was sacrificed for technical considerations rather than for considerations strictly relating to the pathology of the tumour. Apart from these 7 cases, a secondary radical operation was performed

FIG. 534.—Lateral view of face of patient, aged 38, who had had three previous operations for mixed parotid tumour. The scarring from the previous operations, the irregular infiltrating recurrent tumour mass in the upper part of the face, and the incomplete closure of the right eye can be seen. Total parotidectomy with conservation of the intact lower main subdivision of the facial nerve was performed, the large deficiency caused by removal of infiltrated skin being closed by a pedicle skin-flap.

for one of the cases primarily treated by superfacial conservative parotidectomy, a case of carcinoma in which there was early local and glandular recurrence after the primary operation.

Of the 4 cases in which sacrifice of one main branch of the facial nerve was carried out, 2 were cases of carcinoma, 1 of infiltrating cylindroma, and 1 of recurrent infiltrating mixed tumour in which the resected upper branch of the nerve had already been extensively damaged at the original enucleation procedure (*Fig.* 534). Owing to communications

FIG. 535.—Front view of face of patient, aged 56, after right total parotidectomy, with complete sacrifice of the lower main subdivision of the facial nerve for carcinoma of the parotid superimposed on a tumour of 13 years' duration. The only facial palsy is of the right lower lip.

between the terminal branches of the facial nerve, it is possible at times for a sacrifice of even one of the two major divisions of the nerve to be followed by relatively little facial disfigurement. An example is furnished by *Fig.* 535 from a patient in whom the lower main division was excised. Such communications are, however, irregular and inconstant, and the ideal of complete preservation of even the smallest branches of the facial nerve should not lightly be departed from.

Sex Incidence and Age of Onset.—We will not burden the text with a detailed analysis of these factors. The youngest and oldest ages at onset of the mixed parotid tumours were 12 and 69 respectively; of the muco-epidermoid tumours 15 and 61, and of the carcinomata 9 and 74. The only type of parotid tumour with a special sex or age incidence was the adenolymphoma, which occurred particularly in middle-aged men. Of our 7 patients with adenolymphoma, 1 of whom, as already noted, furnished a specimen from each parotid, 6 were men and 1 a woman. The youngest age at onset was 42 and the oldest 67.

Methods of Pathological Study.—

1. The 80 specimens were examined in detail by routine histological methods. Particular attention was paid to the relation of the tumour to the surrounding gland, serial sections being cut of appropriate areas to elucidate particular points. The main object of the investigation was to determine features predisposing to recurrence following local operations such as enucleation.

2. In 15 specimens, all of primary mixed tumour, complete serial section studies were carried out. In 11 the material sectioned was the whole specimen, a total parotidectomy in 4 cases and a superfacial

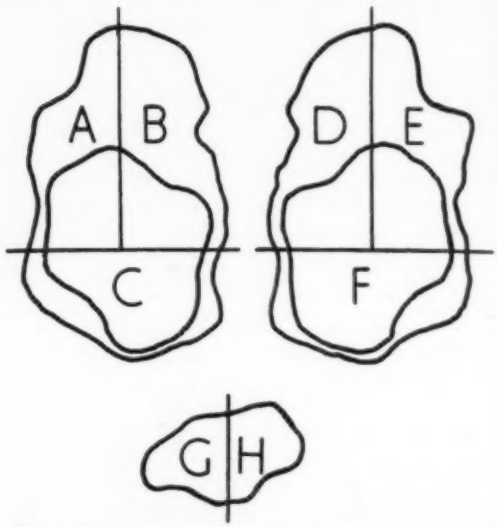


FIG. 536.—Diagram illustrating the division of one of the total conservative parotidectomy specimens into eight blocks for serial sectioning. The two halves of the superfacial part of the gland containing the outlined tumour are shown *above*, the subfacial part *below*.

parotidectomy in 7. In the remaining 4 cases the material sectioned was the apparently normal parotid gland remaining after the tumour had been enucleated from the specimen after parotidectomy, as described under 3. The complete serial section investigation was undertaken primarily to check the hypothesis that recurrences after enucleation are due to the presence within the parotid of independent satellite tumours, but much additional information was obtained both of the border zone between tumour and gland and of the microscopical variations in the parotid gland itself.

The specimens were fixed whole and then sliced in half. After being photographed and described for record purposes, they were divided into blocks of tissue of a size suitable for histological examination (*Fig.* 536), and embedded in paraffin wax. Every tenth section was stained, mounted, and examined, the intervening sections being kept and stained when necessary. The number of sections from each specimen varied from approximately 250 to 1200. From all 15 specimens, some 8000 sections were examined.

3. In 7 parotidectomy specimens, all chosen because they contained primary mixed tumours with

a well-marked plane of cleavage between the tumour and the surrounding gland, the tumour was enucleated from the removed specimen immediately after the operation (*Fig.* 537). The tumour bed and the surface of the tumour were irrigated with 4 oz. of formol saline, and the washings centrifuged, stained,

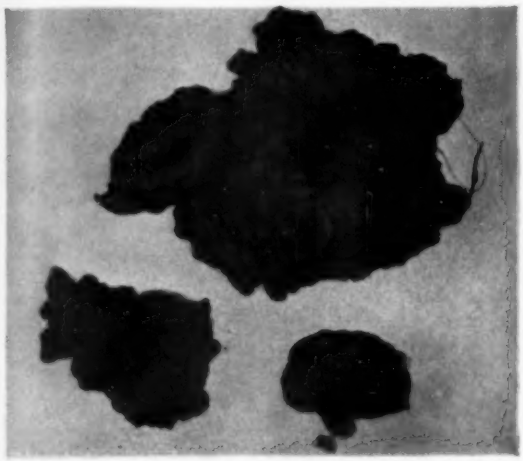


FIG. 537.—A mixed tumour, *bottom right*, which was enucleated from the superfacial portion of the parotid above, after total conservative parotidectomy. The tumour bed is visible below the centre. Subfacial part of gland *bottom left*.

and examined under the microscope. In 4 cases the surrounding gland was submitted to complete serial sectioning, forming part of the investigation described under 2. In the remaining 3 cases the surrounding gland was examined in detail but not by complete serial sectioning. This investigation was undertaken primarily to determine the possibility of cell spill and implantation after enucleation performed under ideal conditions.

RESULTS OF THE PATHOLOGICAL STUDY

In the account that follows we propose less to recapitulate the generally recognized features of parotid tumours than to dwell on those features which have a bearing on treatment.

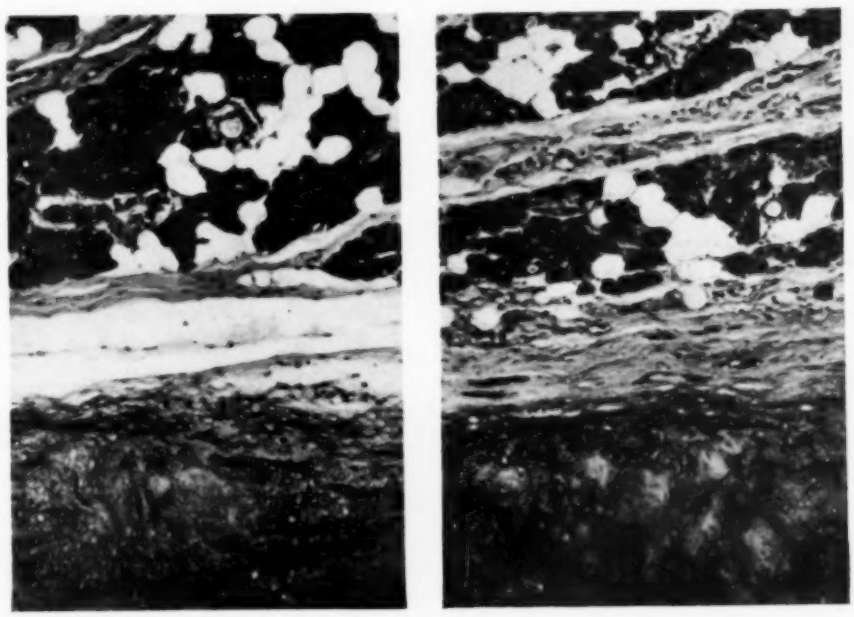
Histological Classification.—

		Total 80 Specimens
Mixed tumour—Primary	37	48
Recurrent	11	
Cylindroma—Primary	1	2
Recurrent	1	
Muco-epidermoid		4
Oncocytoma		1
Carcinoma—Primary	8	9
Recurrent	1	
Lymphoblastic sarcoma		1
Adenolymphoma		8
Cyst		4
Neurinoma		1
Hæmangioma—Primary	1	2
Recurrent	1	

Some of the more important groups in this classification will now be discussed.

Primary Mixed Tumours.—

The Capsule and Planes of Cleavage.—The extent to which there is a condensation of fibrous tissue at the periphery varies not only from case to case, but in different areas of the same tumour. There may be a clear plane of cleavage all round, and in one or two of our specimens it was difficult to prevent the tumour falling out of the gland after bisecting the specimen. In most cases, though there may be a well-marked plane of cleavage between the gland and the tumour capsule for much of its extent (*Fig.* 538 A),



A B

FIG. 538.—A, Clear plane of cleavage between the thin fibrous capsule of a mixed tumour below and the parotid above. B, Another part of same specimen showing no clear plane of separation between tumour below and compressed fibrotic parotid tissue above. (× 80.)

there are places where the tumour and adjoining parotid tissue merge imperceptibly (*Fig.* 538 B). Enucleation through such regions might well leave tumour cells on the surface of the operation site.

Another frequent feature is the presence of a plane of cleavage just below the surface of the tumour due to splitting of the tumour substance. Such splits may of course result from rough handling of the specimen after removal, but they often contain fresh blood, indicating their formation during the early stages of the operation (*Fig.* 539). Recently formed clefts have ragged margins, but if they have been present for some time the lining is smoothed off and they appear as subcapsular cysts (*Fig.* 540). The illustrations make clear the danger of entering

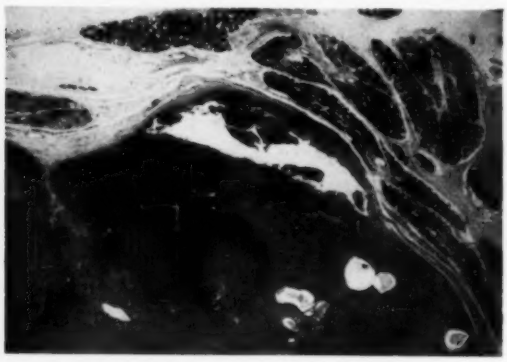


FIG. 539.—Recent split just below the surface of a rounded hummock of mixed tumour. Lobules of normal parotid above and to right. (× 3.)

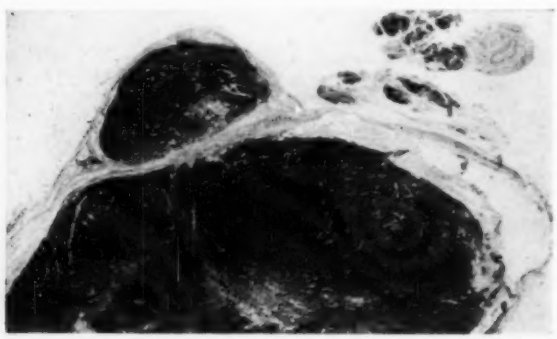


FIG. 541.—Section across a mixed tumour apparently showing a satellite nodule. (× 3·3.)

these false planes of cleavage in the course of an enucleation and leaving behind a layer of tumour tissue in the tumour bed.

Nodular Outline.—A prominent feature of most mixed tumours is their nodular outline. Though often rounded hummocks, the outgrowths may be pedunculated and form peninsulas with narrow necks. In such cases, not only is there a danger that the isthmus may be broken through in the course of enucleation, leaving the nodule behind, but, if such a specimen is sectioned in an appropriate plane, the photomicrograph will apparently show a separate satellite nodule (*Fig.* 541). Such findings are no proof of the existence of separate tumour foci unless serial sections fail to show a connexion. In our cases they always did (*Fig.* 542). A previous statement that such separate nodules of tumour are sometimes present in the gland, based on an investigation in which serial sections were not examined (Patey, 1930), must now be withdrawn.

'*Focal Infiltration*'.—Study of the junctional zone between mixed tumours and the surrounding parotid tissue shows that these tumours grow not only by simple uniform expansion but also by repeated localized infiltration through the capsule. A local break-through with the formation of a salient (*Fig.* 543) is later walled off by fibrous tissue to form either a pedunculated nodular outgrowth or a flattened mushroom-shaped projection. The edge of the breach in the capsule and the increased

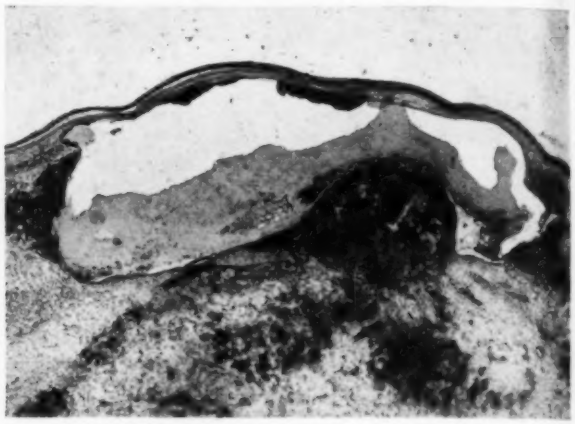


FIG. 540.—A subcapsular split in a mixed tumour, the margins of which have become smooth. Note plaques of tumour attached to capsule. (× 12.)

FIG. 542.—A section farther through the block from which *Fig.* 541 was taken. The connexion between the pedunculated nodule and the main tumour is now shown, but a subsidiary 'satellite' has appeared to the right of the first nodule. There is a subcapsular cleft to the right of the figure. (× 3·3.)

cellularity of another outgrowth are shown in *Fig.* 544. Variations in the degree of cellularity are common and adjoining projections may differ histologically (*Fig.* 545); following the series of sections centrally, however, shows that the two patterns are the result of continuous variation from a common origin. This tendency to grow by intermittent bursts of local infiltrative activity is most strikingly shown in small tumours. Part of the surface of a tumour only $\frac{3}{4}$ in. in diameter is shown in *Fig.* 546. There is no plane of cleavage in the zone of active infiltration, and had enucleation been attempted tumour cells would almost certainly have been left behind. We would like to emphasize that this feature of 'focal infiltration' we regard as a normal phase in the growth of typical mixed tumours, and not as an indication of change to a higher degree of malignancy. It is probable, however, that, were these areas of focal infiltration left after stimulation by an inadequate surgical removal, the apparent recurrence would be

infiltrative. The frequency with which small tumours show areas of focal infiltration into the surrounding gland tissue, a feature which we have not seen previously noted, may account for the often quoted observation of McFarland (1936, 1943) that small tumours are more likely to recur than large ones.

disagree with some of his evidence, particularly his Fig. 8 which we would regard as a sebaceous gland and not a microscopic focus of tumour, this constitutes only a small part of his evidence, and we have no satisfactory explanation to offer for the discrepancy between our findings.

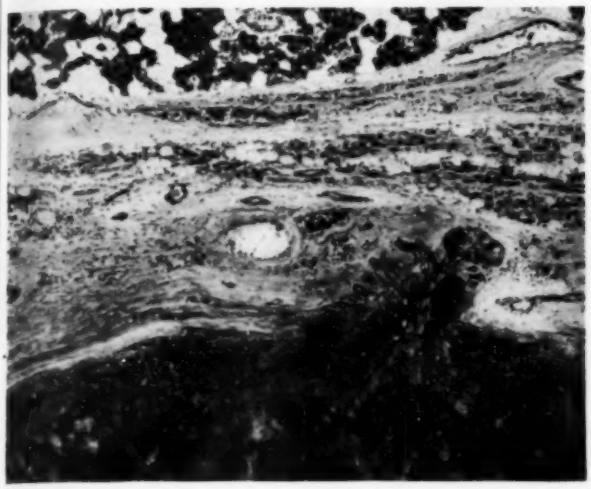


FIG. 543.—Surface of a small mixed tumour showing absence of a clear plane of cleavage and 'focal infiltration' through the fibrous capsule. (× 48.)

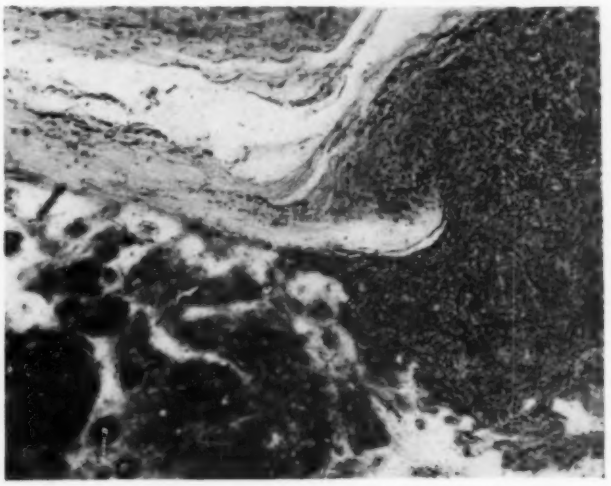


FIG. 544.—The edge of an area of 'focal infiltration through the capsule. Normal capsule and plane of cleavage to left, ruptured edge of capsule to right of centre, and part of cellular protruding nodule on right of field. (× 80.)

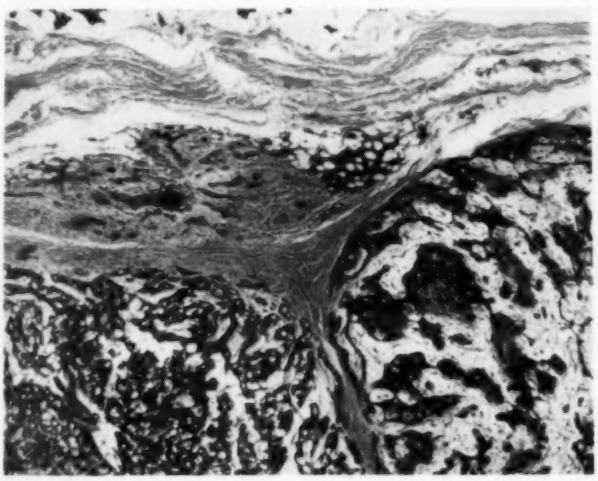


FIG. 545.—Two projecting nodules which have come into contact and show slightly different histological patterns. Compressed and fibrotic lobule of parotid immediately above tumour. (× 32.)

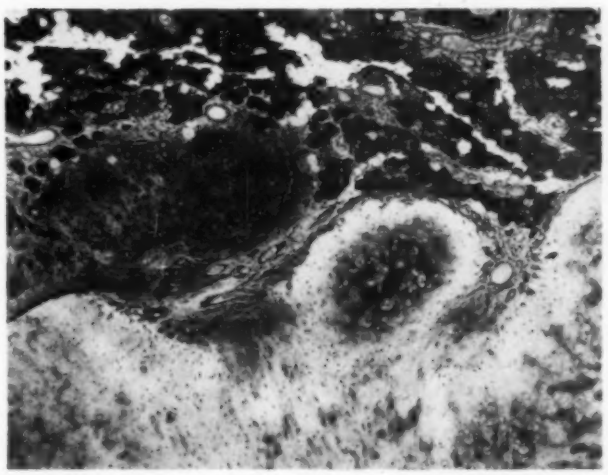


FIG. 546.—Surface of a ¾ in. mixed tumour. Typical pseudocartilaginous nodules on right, markedly cellular proliferating nodule on left merging with parotid tissue all around its margin. (× 32.)

Multiplicity of Primary Mixed Tumours.—The results of our studies on this point may be given very simply and briefly. In none of the 37 specimens of primary mixed tumour, including the 15 in which complete serial section studies were done, did we see a mixed tumour focus separate from the main tumour. Whenever we thought we might have found such a focus, serial section studies always showed a connexion with the main tumour. This finding is in striking contrast with that of Delarue (1956), who in a large series of parotidectomy specimens also intensively studied found multiple foci in approximately 20 per cent. We have carefully studied Delarue's article, and while we would

In the course of our studies we have confirmed the observation of Meza-Chavez (1949) that sebaceous glands are often present in parotids, the seat of mixed tumours. Such glands were identified in all our specimens, sometimes scanty, sometimes up to three or four thousand in the whole parotid (*Fig.* 547). As noted above, they may be mistaken for microscopic foci of tumour. Another appearance encountered several times is shown in *Fig.* 548. Such adenoma-like structures lying in fatty tissue can be shown by serial sectioning to be merely the compact duct system remaining after a lobule of parotid has atrophied consequent on obstruction of the intralobular duct, by a microcalculus in the example

shown. These, too, may be mistaken for independent tumours.

Finally, like many other observers, we have repeatedly noted structures on naked-eye examination of the cut specimen which we thought might be small tumours but which on sectioning proved to be small intraparotid lymph-nodes, some half-dozen or so of which are regularly present.

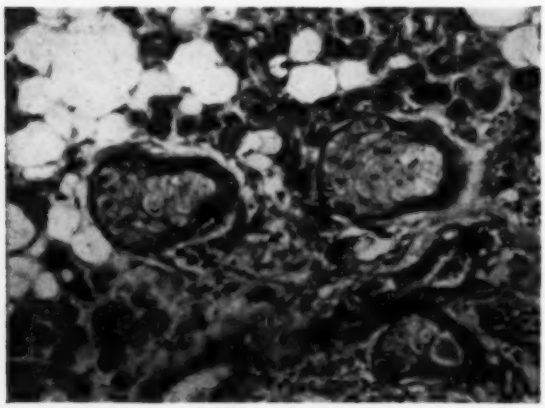


FIG. 547.—Normal sebaceous glands in parotid. (× 127.)

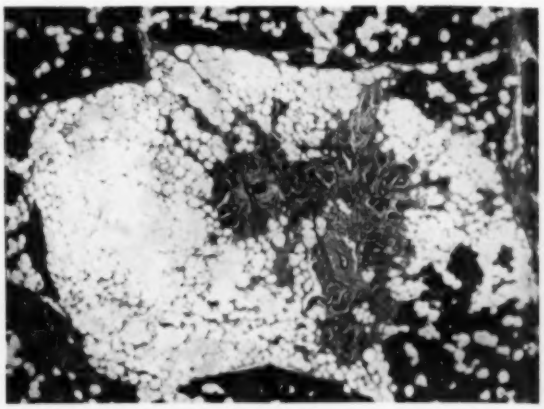


FIG. 548.—Normal parotid tissue at edges of figure. Central area shows a lobule which has atrophied from obstruction of its duct. Surviving ductules have an adenoma-like arrangement. (× 20.)

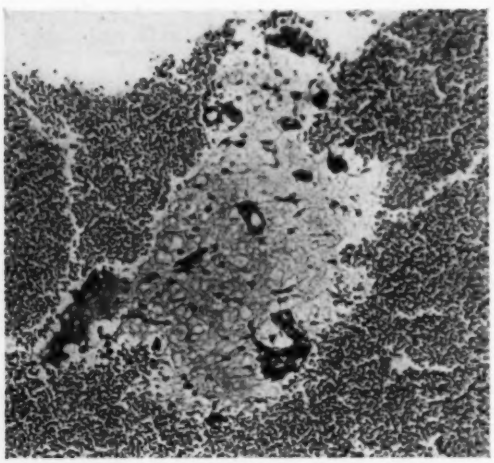


FIG. 549.—Fragment of mixed tumour surrounded by red cells in washings of tumour experimentally enucleated shown in *Fig.* 537. (× 96.)

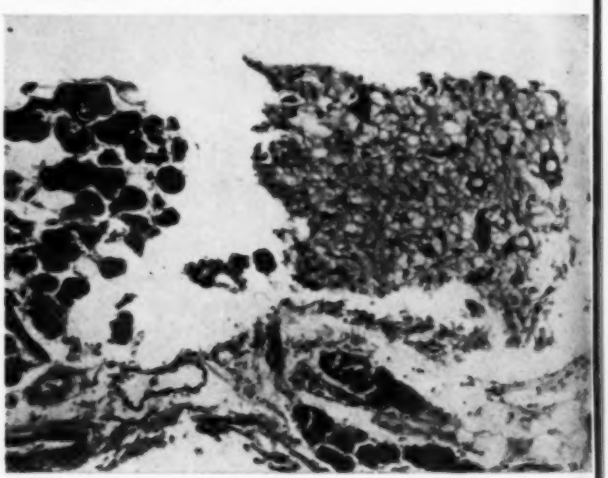


FIG. 550.—Fragment of tumour tissue adherent to tumour bed shown in *Fig.* 537. (× 96.)

Experimental Evidence of Spill and Implantation.—In one of the cases of experimental enucleation in parotidectomy specimens described above under 3, a tiny rupture a millimetre or so in diameter occurred accidentally at the site of a soft projecting nodule of tumour. In this case both the washings and the tumour bed showed obvious collections of tumour cells (*Figs.* 549, 550). In none of the other 6 cases were there similar findings.

Recurrent Mixed Tumours.—The most striking feature of recurrent mixed tumours is their multiplicity, multiple nodules being the rule and the nodules often being separated by a considerable distance. Foote and Frazell (1953), Delarue (1956), and Ackerman and Wheat (1955) all agree on this, and the last have furnished proof by serial sectioning. Multiplicity seemed so obvious in recurrent tumours that we hesitated to undertake the heavy task that complete serial sectioning of even one specimen represents. We have, however, proved the separate nature of a few nodules by limited studies. A common site for the multiple nodules is the skin at the scar of the previous incision (*Fig.* 551). The obvious multiplicity of recurrent tumours, taken in conjunction with the difficulty admitted even by Delarue of demonstrating multiplicity in primary tumours, strongly suggests that the important mechanisms of recurrence are the leaving behind of outlying projections of tumour and implantation. The deposits in the scar can only be the result of implantation. The final feature worthy of mention in recurrent mixed tumours is the occurrence of gross macroscopic infiltration (*Fig.* 534).

Cylindroma.—This tumour, with its characteristic cylindromatous or basaliomatous pattern and its habit of slow but relentless local infiltration, is fortunately uncommon in the parotid, though it forms a high percentage of tumours of the minor salivary glands and of the mucous glands of the upper respiratory tract (Ranger, Lucas, and Thackray, 1956). American workers tend to classify this tumour

with the carcinomata—'adenoid cystic carcinoma' being the term most often employed—and certainly it may metastasize, retaining its typical histological appearance. A greater danger, however, is the onset of higher grade malignancy, both histologically and in behaviour, with rapid local spread and metastasis. Though there were only 2 typical cylindromatous tumours in the series, there were 3 spheroidal-cell carcinomata in which areas were found suggesting that they had developed from cylindromata. The 2 examples of cylindroma in the series conformed to type both histologically and in their tendency to infiltration. In one case the upper part of the masseter (*Fig.* 552) and the upper division of the facial nerve (*Fig.* 553) were invaded and had to be resected. In the other, a case of recurrent tumour which had apparently arisen in the subfacial parotid, almost the whole of the masseter was invaded and had to be removed, though in this case it was possible to preserve intact the facial nerve.

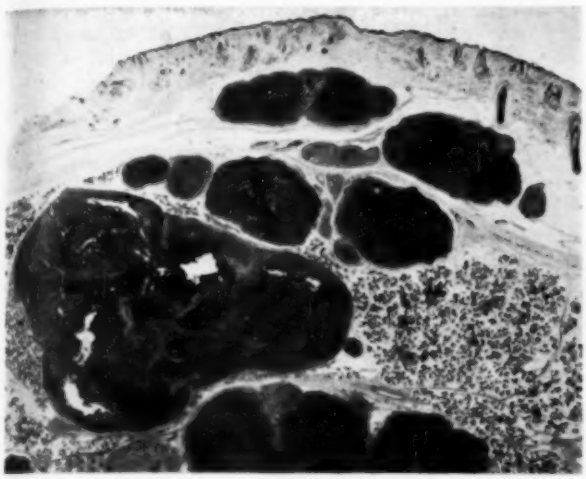


FIG. 551.—Section through skin and part of parotid showing many nodules of recurrent mixed parotid tumour. Note nodules in skin adjoining the slightly depressed scar. (× 3.)

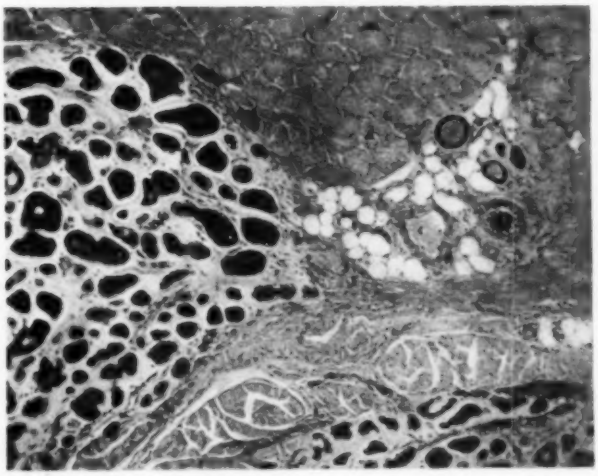


FIG. 552.—Cylindromatous tumour from parotid invading masseter. (× 52.)

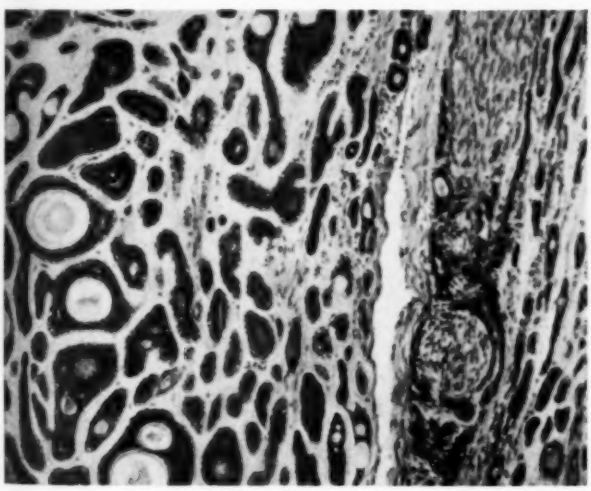


FIG. 553.—Typical cylindromatous tumour in parotid. The characteristic way in which it grows in the sheath of branches of the facial nerve is shown on the right. (× 52.)

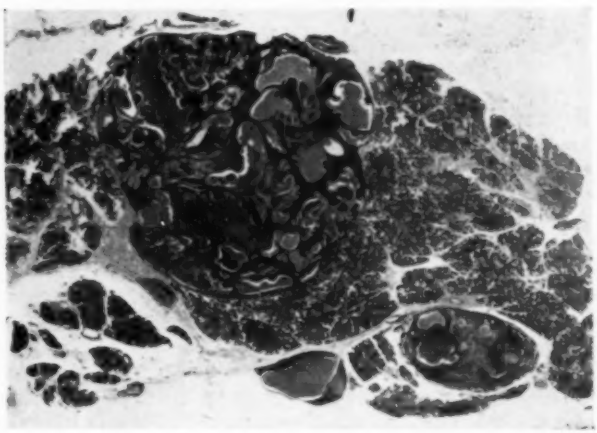


FIG. 554.—Section right across a parotid showing three separate and distinct adenolymphomata. (× 3.)

Muco-epidermoid Tumours.—There were 4 examples of this recently segregated type of tumour (Stewart, Foote, and Becker, 1945), the behaviour pattern of which, like that of cylindroma, seems to lie somewhere between that of mixed tumour and carcinoma. There is no capsule and often gross infiltration outside the gland is present, though the tendency to infiltration seems a little less marked than in cylindroma. In all 4 cases we were able to preserve the facial nerve, but in one there was invasion of the masseter, a large part of which had to be resected, and in another the tumour recurred, infiltrating the upper attachment of the sterno-mastoid, which had to be resected at a second operation. In the latter case there was also a metastatic deposit in one of the upper deep cervical lymph-nodes. Apart from the carcinomata, this was the only lymphatic metastasis in the whole series. This patient and the patient with invasion of the masseter are both alive and well, and apparently free of growth, 4 years after their conservative parotidectomies.

Adenolymphoma.—There were 8 parotidectomy specimens of this tumour obtained from

7 patients, in 1 case the tumour being bilateral. Our most striking finding was that in 4 out of 5 specimens in which a fairly intensive search was made, but which did not in any way constitute complete serial sectioning of the gland, other unsuspected separate and discrete tumours of similar nature were found (*Fig.* 554), in one case in the subfacial parotid. The 12·2 per cent recurrence rate noted by Frazell (1954) in 49 tumours is thus explained. In fact, such a rate

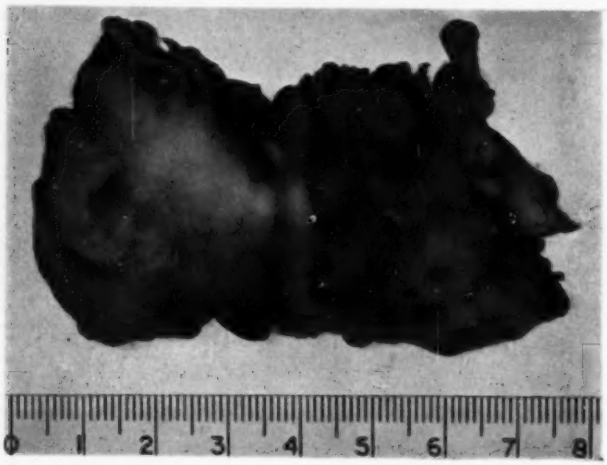


FIG. 555.—Bisected parotidectomy specimen showing a sharply defined slightly bluish long-standing mixed tumour on the left with a broad ill-defined white zone of anaplastic carcinoma extending from it to the right. Hyperplastic, but uninvaded, lymph-nodes at the opposite end of the gland.

is surprisingly low, and probably indicates a low growth potentiality of these tumours so that they only exceptionally become manifest.

Cysts.—In one of the 4 cases of cysts another unsuspected separate cyst was found in the same gland. Otherwise the findings revealed little of note, and in particular there was no evidence of intracystic tumour. In a previous series, however, we have encountered such intracystic tumours in 2 cases (Patey and Hand, 1952).

Hæmangioma.—The two cases of hæmangioma on which we operated conformed to type in being congenital and in appearing in infancy or early childhood. The primary tumour, a cavernous hæmangioma with large cavernous spaces situated almost entirely in the superfacial parotid, was successfully treated by superfacial conservative parotidectomy. The recurrent tumour was a capillary hæmangioma, and a subtotal facial palsy had been produced by the original operation, the exact nature of which we do not know.

Carcinoma.—Of the 9 cases of carcinoma, 4 were classified histologically as spheroidal-celled, 3 as spindle-celled, and 1 each as epidermoid and adenocarcinoma. It has already been noted that we do not use the term 'adenocarcinoma' to include cylindromata, as is the custom with many American authors. The diagnosis of carcinoma was made clinically in one case from the presence of paralysis of the facial nerve, and in another from the presence of an enlarged hard, upper deep cervical lymph-gland. The diagnosis was also occasionally suspected from a history of recent activity in a previously inactive tumour, but such activity is by no means a certain indication of carcinoma. In many cases, however, the diagnosis of carcinoma came as an unexpected finding at the operation or on subsequent histological examination. In 3 cases the history was a short one of weeks or months. In one of these the facial paralysis was noted by the patient before the tumour, the latter only being discovered when she reported to the doctor. In this patient the tumour was found at operation to have infiltrated into the stylomastoid foramen, a finding which we have only seen in one other case, that of the lymphoblastic sarcoma.

Carcinoma of the parotid may metastasize like carcinoma elsewhere to the lymph-nodes and by the blood-stream. The intraparotid lymph-nodes may be the first to be involved. Three cases have died of recurrence, the only deaths and the only cases of recurrence so far, apart from the case already mentioned of muco-epidermoid tumour with an infiltrative recurrence in the sternomastoid.

A striking feature in some cases was the long history of a tumour, e.g., 6, 13, 16, and 20 years. Theoretically, either the tumours might have been biologically inactive carcinomata all the time, or their activity may have depended on a change of histological type. In 3 cases there was histological evidence of mixed tumour and in 3 of cylindroma; in one of the former, the remains of the original tumour, which had been present for 13 years, were easily recognizable on naked-eye examination (*Fig.* 555). We are of the opinion, therefore, that carcinoma of the parotid with a long history of a tumour usually indicates a change of histological type, and not the conversion of a biologically-inactive to a biologically-active carcinoma. This latter possibility cannot, however, be dismissed.

DISCUSSION

The above findings will be discussed under the following headings: (1) The malignancy of parotid tumours; (2) Clinical diagnosis; (3) Biopsy of parotid tumours; (4) The bearing of the pathological findings on treatment.

1. The Malignancy of Parotid Tumours.—It is usual to regard typical mixed parotid tumours as innocent, though some authors postulate semi-malignant and malignant groups (Ahlbom, 1935; Foote and Frazell, 1953; Zymbal, 1938). However, since typical mixed tumours may recur, easily become implanted, frequently show infiltration microscopically in their primary phase and macroscopically in their recurrent phase, and sometimes kill, it is difficult to regard them as completely innocent. The cylindromata, muco-epidermoid tumours, and carcinomata clearly have malignant characteristics.

2. Clinical Diagnosis.—Of the 80 cases, 66 were examples of primary tumours and 14 of recurrent. In most of the primary cases an accurate clinical diagnosis was not possible. Parotid tumours of all types present as localized lumps in the parotid, as a rule growing fairly slowly, though occasionally showing phases of rapid growth. Intraglandular infiltration gives rise to no diagnostic clinical features until the facial nerve is involved, which is usually late. Even extraglandular infiltration, as of the

masseter, is often not diagnosable clinically. Of the 66 primary tumours, 37 were finally classified as mixed tumours and 29 under one of the other headings. If to this latter group are added the tumour-simulating inflammatory swellings of the parotid and of the intraparotid lymph-nodes, and the lymphomatous tumours, it will be seen that the common practice of diagnosing a localized lump in the parotid gland as a mixed tumour depends only on a mathematical probability which is not unduly high and which may even approach an even chance (Patey and Hand, 1952).

3. Biopsy of Parotid Tumours.—The impossibility of making an accurate diagnosis clinically in most cases naturally raises the question of a preliminary biopsy. We have not adopted this course as a routine, partly because of the difficulty that may arise in making a diagnosis from a small sample of what may be a heterogeneous tumour; partly because of the implantative and infiltrative tendencies of parotid tumours when cut into. Thus, we have had one case in which, following a preliminary biopsy of a mixed tumour elsewhere, there was well-marked skin infiltration at the site of the scar of the incision (*Fig.* 556); and another of similar infiltration of the muscle and mucous membrane of the palate following a transpalatal biopsy of a pharyngeal extension of a mixed parotid tumour. We have occasionally taken a piece of tumour for rapid microscopical examination during operation, if it was thought that the examination would help in the decision on the exact operation to perform. In general we would agree with Janes (1957) that the behaviour of the tumour as judged by the macroscopic findings after wide exposure of the parotid is the best guide to treatment.

4. The Bearing of the Pathological Findings on Treatment.—This may be conveniently discussed under the two headings: (*a*) The timing of operation; (*b*) The type of operation.

a. The Timing of Operation.—Before the development and standardization of the operation of conservative parotidectomy, there was a tendency to avoid or delay operations on parotid tumours for fear of the facial nerve. This tendency was reinforced by the observation of McFarland that recurrence seemed to be more common in early and small tumours. Though this conclusion has been much criticized, we have already noted the histological evidence in its support found in this study. Another factor tending to limit operations on parotid tumours was that, whereas the natural history of most primary mixed parotid tumours is to increase in size but otherwise to cause no trouble, recurrences are often infiltrative and sometimes fatal. The weakness, however, of a non-intervention policy in any tumour of unknown nature is that the tumour may be malignant or become malignant. That this applies to the parotid is obvious from both the present and other series of cases. The development of an efficient method of removing parotid tumours without undue danger to the facial nerve automatically condemns a policy of inactivity.

b. The Type of Operation indicated.—It is proposed to discuss under this heading only broad general principles and not technical details. An important preliminary point is that, since an absolute diagnosis of the nature of a parotid tumour is usually not possible clinically, most operations on the parotid are primarily explorations.

Primary mixed tumours: The pathological case against enucleation of primary mixed parotid tumours is strong, but should not be weakened by overstating it. As shown by our experimental enucleation studies, it is frequently possible under ideal conditions

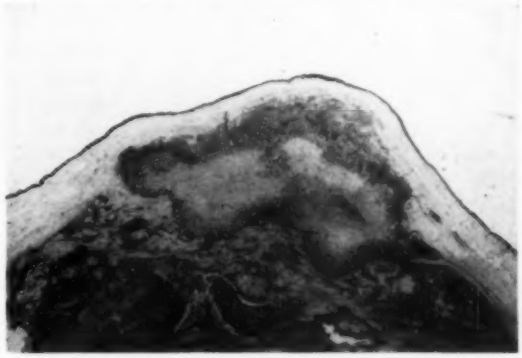


FIG. 556.—Mixed parotid tumour and overlying skin. At the centre of the field the skin is raised by an irregular infiltrating nodule at the site of a previous biopsy. (× 4.)

to remove mixed tumours completely by enucleation, a conclusion supported by the evidence of the long-term results of this procedure. But conditions at operation are often far removed from those obtaining in experimental enucleation, when the parotid with its contained tumour lies in one's hand. In particular, if the tumour lies deep to the facial nerve, removal without sacrificing the nerve may only be possible after mobilizing completely the main trunk of the nerve and all its branches. The main pathological arguments against enucleation of mixed tumours are: firstly, that in an appreciable minority of cases enucleation is likely to leave behind marginal areas of tumour tissue; and, secondly, that enucleation is associated with a special danger of implantation recurrence due to spilling from accidental breaches of the tumour surface.

We have only a little evidence bearing on the efficacy of irradiation as a means of remedying the potential deficiencies of enucleation. One of our recurrent cases had been treated by a radium needle implant into the tumour cavity after the enucleation; another by immediate intensive post-operative X-irradiation; and several by irradiation for the developed recurrences. Though much has been written on this subject, one of the few attempts at a controlled experiment of which we are aware is that of Zymbal (1938). In a follow-up study, much of which was short-term, he had 4 recurrences in 34 cases in which radium had been inserted into the tumour cavity after enucleation, and only 1 in 28 cases in which radium had not been inserted. In general, a fair conclusion for the parotid, as elsewhere, would appear to be that irradiation should not be used merely as a cover for inefficient surgery.

The only type of operation for primary mixed tumours of the parotid which will be pathologically sound in all cases is wide excision, i.e., some type of parotidectomy. Since primary mixed tumours push aside, rather than surround or infiltrate, the facial nerve, preservation of the nerve, i.e., conservative

parotidectomy, is possible in the great majority of cases. The smaller the tumour at the time of the operation, the greater the chance of removing a wide margin of normal parotid tissue between it and the nerve, and the sounder therefore the operation. The surgical, anatomical, and technical considerations involved in conservative parotidectomy have been discussed elsewhere (Patey and Ranger, 1957). For both pathological and anatomical reasons, we favour as the standard operation removal of the whole of the parotid superficial to the facial nerve, including the main parotid duct, i.e., superfacial conservative parotidectomy. We only proceed to removal of the remaining subfacial portion of the parotid, i.e., total conservative parotidectomy, if the tumour arises in or is closely adjacent to this portion. Should further work or long-term results confirm the conclusions of Delarue (1956) on the frequency of multiplicity of primary mixed parotid tumours, we shall not hesitate to follow Redon (1955) in performing routine total conservative parotidectomies. In view of our own findings, however, we are not at present doing so. In all operations particular care ought to be taken to avoid spill of tumour cells, either from rupture of the tumour or from its puncture by a sharp retractor. As an additional precaution against implantation recurrence, we have lately adopted the practice of irrigation of the operation area at the end of the operation with 1–500 perchloride of mercury followed by saline.

Recurrent mixed tumours: The multiplicity and widespread character of recurrences of mixed tumours obviously render conservative parotidectomy a less sound procedure pathologically than it is for primary tumours. The operation is, however, technically feasible in most cases without compromising unduly with pathological principles. We have reserved major sacrifice of the facial nerve for the cases in which gross infiltration is present. Owing to the frequency of implantation deposits in the scar, the old incision should always be excised, preferably in continuity with the tumour. A recurrence is more difficult to get rid of than the primary tumour. Thus, out of 34 recurrent mixed tumours from Zymbal's Leningrad series, 13 had recurred more than once—8 twice, 3 three times, and 2 four times. This type of experience, which we have also had, emphasizes the importance of making the first intervention decisive and definitive.

Cylindromata and muco-epidermoid tumours: These may be considered together as tumours in both of which local infiltration is common. Complete preservation of the facial nerve is usually possible if operation is carried out without undue delay, even though removal of infiltrated masseter may not infrequently be necessary. In advanced cases radical removal may be necessary.

Adenolymphoma: Adenolymphoma has always been quoted in the past as the strong argument against conservative parotidectomy as a standard operation, on the grounds that this tumour is undoubtedly innocent and readily cured by enucleation. In view of our demonstration that multiplicity is the rule rather than the exception in adenolymphoma, on strict pathological grounds total parotidectomy should be carried out. We have, however, in practice not followed the logic of our own arguments, and have usually contented ourselves with a superfacial parotidectomy, relying rather on the postulated low growth potentiality of these tumours. Only the future will show the soundness of this practice.

Cyst: Apart from the finding of another separate unsuspected cyst in one case, our pathological findings in this series do not afford support for routine parotidectomy for cysts. In view, however, of the occasional occurrence of tumour tissue in the walls of cysts previously noted we feel that routine superfacial parotidectomy is not unjustified, particularly since some form of excision is the only cure for parotid cysts.

Hæmangioma: As already noted, we treated one large primary cavernous hæmangioma by a superfacial parotidectomy, the tumour being almost entirely in the superfacial portion of the parotid gland. The operation was uneventful, but the sight of the large vascular spaces was a constant stimulus to the operator to avoid impingeing on the tumour. Another case of primary hæmangioma which we did not operate on appeared from X-ray examination after injection of radio-opaque dye to involve the whole of the gland. Since the boy was very little inconvenienced by the presence of tumour, we have so far refrained from operating. The splitting of a very vascular cavernous angioma in order to preserve the facial nerve might be a very unpleasant experience. This is the only case since January, 1952, in which we have refrained, because of the facial nerve, from doing the operation we thought to be indicated on pathological grounds.

Carcinoma: Carcinoma of the parotid of a very high degree of malignancy seems as unamenable to surgery as are similar tumours elsewhere. In the parotid, however, a high proportion of carcinomata develop in tumours that for varying periods of time are inactive. There would therefore seem to be a reasonable hope that operation at this inactive stage would effect a cure, and this is one of the chief justifications for the policy of routine immediate operation on all parotid tumours.

We have no special observations to make on the question of block dissection of the neck in carcinoma of the parotid, except that in cases in which it is necessary the results are likely to be bad. With regard to our observation of the occasional spread of tumour into the stylomastoid foramen, however, we may briefly note the slight variation of the standard technique of radical parotidectomy that we adopted to deal with it. As soon as it became clear that the tumour was spreading to the neighbourhood of the stylomastoid foramen, all further exploration in this region was stopped until the gland had been completely freed elsewhere. The tumour was then finally freed by chiselling off the mastoid and styloid processes, which together with the lower end of the stylomastoid canal were removed attached to the tumour.

CONCLUSIONS

To summarize our conclusions on the relation between the pathological findings and treatment, parotid tumours range between those that under ideal conditions may be successfully treated by enucleation at the one extreme (though the uncertainty of this procedure renders it undesirable

as a routine); and at the other those in which no form of treatment is likely to be of any use. The great majority, however, can be successfully treated by following the two standard principles of the surgery of tumours—early operation and wide removal. In practice, surgeons operating on parotid tumours should have command of all the techniques that may be found necessary after what is at first an exploratory procedure.

SUMMARY

1. The results are reported of a clinico-pathological study of parotid tumours extending over approximately six years, and including all cases of these tumours referred for treatment during this period.

2. Seventy-nine consecutive parotidectomy specimens have been studied, and one of recurrence limited to the skin scar.

3. Special methods of study have included (*a*) complete serial sectioning of glands and their contained tumours; and (*b*) 'experimental enucleation' of encapsulated tumours from parotidectomy specimens, and examination of the tumour bed and of washings of the tumour surface.

4. The factors responsible for recurrence of primary mixed tumours after enucleation are two—the leaving behind of peripheral nodules and implantation. We found no evidence that multiplicity of tumour foci is a factor.

5. A method of growth of primary mixed tumours by phases of 'focal infiltration' is described. This feature is common in small tumours and explains the special frequency of recurrence after enucleation of small and early tumours noted by McFarland, a finding which has hitherto appeared anomalous.

6. Recurrent mixed tumours are as a rule multiple, and implantation in the scar of the original incision is a common finding.

7. Cylindromata and muco-epidermoid tumours are characteristically infiltrating tumours.

8. Adenolymphomata are usually multiple, and often bilateral. This multiplicity is the probable cause of the not infrequent recurrences noted after enucleation.

9. Carcinoma is frequently superimposed on an inactive tumour of many years' duration. Developed carcinomata tend to be highly malignant.

10. An accurate diagnosis of the nature of a parotid tumour is usually impossible clinically.

11. Pre-operative biopsy of parotid tumours is in general undesirable as encouraging spread, and operative biopsy should be reserved for special cases.

12. Parotid tumours are all best regarded, and treated, as malignant or potentially malignant, and operated on early.

13. The best treatment for most parotid tumours is some form of conservative parotidectomy, i.e., parotidectomy with preservation of the facial nerve, but for infiltrating tumours resection or partial resection of the facial nerve may occasionally be necessary. The exact procedure indicated can only be determined after wide operative exposure.

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THE SURGERY OF THE OSTEO-ARTHRITIC HIP

By PHILIP WILES

The hip-joints became of increasing importance as man assumed an upright posture and adopted the mode of bipedal terrestrial progression. They were then called upon not only to adapt themselves to this major change in posture, but they had also to transmit the entire body-weight, and they became necessary for the natural performance of nearly every movement. The economy in design of the hip is striking. It is a straightforward ball-and-socket joint, the simplest way of providing for movement in every plane whilst giving strength and stability. This arrangement does, however, render the joint particularly liable to mechanical derangement, and once the bones composing it have become distorted, the interference with function is necessarily severe. At one time it was thought that the structure of the joint, together with the hard work it is called upon to perform, explained the high frequency of degenerative changes. The present tendency, however, is to incriminate the arrangements for nourishing the articular cartilage. Whatever the reason, degenerative arthritis is only too common, and being a painful complaint it interferes gravely with the life of the unfortunate victim.

The methods available for the treatment of the painful hip are those applying to most orthopædic problems—*move it, keep it still, or cut it out*. In the very early stages it may be possible to delay the progress of the degenerative process by reducing the patient's weight to decrease the pressure on the joint, and by giving deliberate exercises to maintain as full a range of movements as possible. When the symptoms have become severe, conservative measures are of little real value. Physiotherapy, manipulation, radiotherapy, and intra-articular injections are often prescribed, but more to assure the patient that an attempt is being made to help him than in the hope of giving lasting relief. The more conservative operations such as denervation and excision of the joint capsule give only temporary benefit. It is sad and depressing that there are virtually no half-measures in treatment. The patient has to grin and bear it, adapting his life as best he can, until such time as the symptoms become intolerable. Major surgery must be postponed until there is a strong probability that it will make the condition better and not worse. The choice is then between attempting to give a movable joint by some form of arthroplasty or an osteotomy, keeping it still by arthrodesis, and cutting out the head of the femur.

ARTHROPLASTY

The advantages of movement at the hip are clearly so great that surgeons have been striving since the dawn of modern surgery to find a way of retaining or restoring movement when the hip is diseased. Progress has been made, many methods have been tried, but none has stood the test of time, and although there are many brilliant exceptions, there is as yet no procedure that can be relied upon to give a good and lasting result.

The earliest arthroplasties were performed with the intention of mobilizing ankylosed joints. The joint surfaces were refashioned and then neighbouring soft tissue or some sort of foreign substance was interposed to prevent their fusing again. Until a few years ago nearly every effort was directed towards finding a suitable material to place between the bones. The idea was pioneered at the end of the last century by Ollier, who interposed the periarticular soft tissues. Within a few years experiments, usually but not always in animals, had been made with a great variety of materials ranging from pig's bladder to rubber sheeting, zinc foil, and collodion. In 1902 Robert Jones successfully reconstructed a hip using gold foil, and in the same year Murphy obtained a good result by interposing a flap of fat and fascia. A little later Whitman described a reconstructive procedure in which the head and neck of the femur were excised and the greater trochanter was transplanted to a lower level. Until the second world war, the few surgeons bold enough to advise arthroplasty of the hip used either the Whitman procedure, or the Murphy technique as developed by Vittorio Putti, Willis Campbell, and others. Attempts to find a better method were, however, unremitting, but the search always was for a better way of refashioning the joint and a better substance to interpose.

The author was comparatively late in the field. His first attempt, using the cat as an experimental animal, was to spray metal on to the denuded joint surfaces. It failed, if only because the metals that can be melted quickly enough in an oxy-acetylene flame are unsuitable to leave permanently in the body. Next, in 1938, he tried inserting a pre-formed acetabulum and femoral head made of stainless steel with the two parts ground to fit accurately. The acetabulum was prevented from rotating by a couple of screws, and the femoral head was secured by a bolt passing through the neck of the femur. The animal experiments were promising, and the operation was performed six times on patients severely crippled by Still's disease. There was a measure of success in that those who were previously bed-ridden were thereby enabled just to walk. All these patients are now believed to be dead of other causes; the radiographs of their hips were destroyed during the war, not by enemy action but deliberately by those responsible for the care of hospital records. One patient who had both hips operated upon in 1938 was alive in 1951, thirteen years later, but she can no longer be traced. She then had some 20° of active flexion at each hip and, although many other joints were stiff, she could walk a little and operate a mechanically propelled chair. The acetabular portions of the prostheses were disintegrating (*Fig.* 557), but there was no pain.

Mould Arthroplasty.—The credit for putting arthroplasty of the hip firmly on the surgical map goes to Smith-Petersen, of Boston. He described the anterior approach to the hip which goes by his name in 1917 whilst he was still a resident, and in

1923 he performed his first arthroplasties. He began by interposing a glass mould between the refashioned joint surfaces, but sometimes it broke during use. Not deterred, he tried a variety of other substances such as pyrex and bakelite until in the end he settled on vitallium. The technique gradually developed in his hands and he designed a number of instruments specially contrived to combine accurate work with the least possible tissue damage. The operation reached its final form in 1938, and by 1947 he had operated upon more than 500 hips in 420 patients. A surgeon of great skill, an enthusiast, and a man of endearing personality, he nursed back the function of each hip; and he retained the confidence of his patients so that when further trouble arose, as sometimes happened, he was still

FIG. 557.—A ball-and-cup arthroplasty performed in 1938. Radiograph thirteen years later. The lug and screws retaining the metal acetabulum have disintegrated, much of the neck of the femur has been absorbed, and the bolt has broken away from the head.

FIG. 558.—A mould arthroplasty after 5 years. The neck of the femur has been absorbed, the mould is in contact with the trochanters thus preventing movement, and pain has returned.

FIG. 559.—A Judet type arthroplasty after 3 years. The bone of the neck, unable to withstand the stresses placed on it, has been absorbed and the pain has returned.

FIG. 560.—A Judet type arthroplasty after 2 years. The stem of the prosthesis has broken.

able to encourage them and help them, even on occasion by ' revision ' of the arthroplasty.

The mould arthroplasty made it possible for the first time to give the sufferer from a painful hip at any rate the hope of losing his pain without sacrificing movement and stability. The operation was adopted with enthusiasm by surgeons throughout the world, but it was soon apparent that every problem

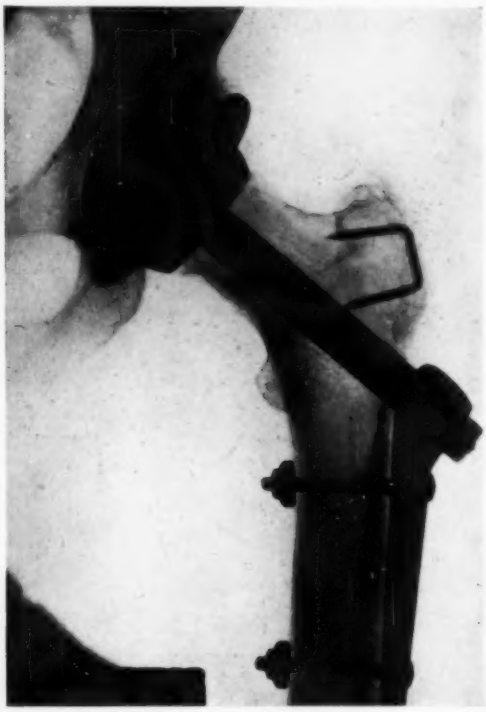


FIG. 561.—A ball-and-cup arthroplasty after 1 year. The stem is sliding outwards showing that the neck is being absorbed. (A posterolateral approach was used with a staple to re-attach the smaller gluteal muscles.)

had not been solved. A few patients had no relief from pain; the re-fashioned bone, especially if it were previously diseased, did not always tolerate the new stresses placed upon it and gradually became absorbed; osteophytes grew on the neck of the femur and prevented movement of the head within the mould; the new joint capsule composed of scar tissue became painful. So it happened that the pain, even though relieved at first, not infrequently returned after a few years (*Fig.* 558). Many of Smith-Petersen's early patients still have painless hips (Aufrank, 1957), but other surgeons, perhaps because their discipline was less meticulous, or because they magnified the imperfections of their results, soon found themselves impelled to resume the search for yet a better method. This time, however, the inquiry was in a different direction and the emphasis changed from re-fashioning the joint to replacing it.

Replacement Arthroplasty.—The era of ' replacement ' or ' prosthetic ' arthroplasty was ushered in by the brothers Jean and Robert Judet, of Paris, in the late nineteen-forties. These surgeons removed the femoral head and replaced it with a new one made of acrylic resin. The operation was attractively easy to perform and the early results were brilliant, but, alas, pain returned only too quickly. The shape of the prosthesis has since been modified, and it has been copied in steel, vitallium, and other materials, but the procedure, at any rate in the hands of British surgeons, has not given lasting results and now is seldom practised.

There are at least three reasons for the frequent failure of this type of prosthesis. Firstly, the bone, unable to withstand the stresses placed on it, is

FIG. 562.—A Thompson prosthesis inserted in an attempt to salve a failed Judet type arthroplasty.

absorbed and the prosthesis becomes loose (*Fig.* 559). Secondly, the acetabulum cannot be shaped to fit the prosthesis really accurately and the spaces that remain are filled with fibrous tissue which may become painful, particularly after damage by some unusual strain. And thirdly, it is difficult to design a strong enough prosthesis; those made of acrylic resin rub flat surfaces on themselves, or they fragment or break (*Fig.* 560), and those made of steel sometimes become fatigued and break.

The author, in an attempt to overcome these difficulties, revived his earlier apparatus in a modified form (*Fig.* 561). It was designed to transfer the stress from the cancellous bone of the head of the femur to the dense cortical bone of the shaft. The stainless-steel acetabulum and femoral head fitted accurately. The acetabulum had a flange around it to discourage encroachment by scar tissue, and it was prevented from rotating by three pins projecting from the rim. The head of the prosthesis was hollowed to reduce the amount of bone removed, and it had a cutting edge to ensure a close fit with the bone. The stem was 4-flanged to increase its strength, and it fitted into a round hole in the plate so that it could slide outwards should the bone absorb.

The apparatus was used eight times, but the results were not encouraging. Stability was good

in all cases, but there was reasonable movement only in 6; in the other 2 movement was prevented by a great mass of new bone which encircled the joint. In 3 patients the bone absorbed slowly, allowing the stem to slide laterally and project beneath the skin (*Fig.* 561). The results could be regarded as tolerably satisfactory in 2 patients only. Even were the known difficulties overcome, it would still be doubtful if the steel and the bone to which it is attached could withstand for many years the great stresses and strains placed on them.

The failed replacement arthroplasty has created a formidable surgical problem, and one that now is only too common. The number of prostheses actually in use cannot be calculated but some idea is given by a survey conducted on behalf of the American Academy of Orthopædic Surgeons (Lambert, 1956). It was found that 8384 prostheses of thirty varieties had been inserted during the two years October, 1952, to October, 1954, by the 58 per cent of the members of the Academy who answered the questionnaire. The number by now inserted in the whole world may well be over 50,000. The surgical problem arises partly because the head of the femur—Smith-Petersen called it "the working stock"—has been removed and this makes even an arthrodesis exceptionally difficult. Perhaps the most hopeful attempt at solution, at any rate in elderly patients, is to replace the prosthesis with another of the Austin Moore or Frederick Thompson type (*Fig.* 562). The stresses set up by these appliances are such that both the bone and the metal may be expected to withstand them for quite a long time. They are now in common use not only in attempts at salvage after other kinds of prostheses have failed, but also as a primary operation for the relief of pain in osteo-arthritis. It is said that one manufacturer alone had sold more than 10,000 by the end of 1956.

Every surgeon can produce the brilliant results of arthroplasty, but occasional, or even frequent, success is not enough. The operation is intended to relieve pain, not to save life, and the failures are of equal importance. A failed arthroplasty may mean worse pain, greater disability, and perhaps a succession of major operations. Margaret Shepherd (1954), on behalf of the British Orthopædic Association, made a careful personal examination of a considerable number of patients who had undergone mould and acrylic replacement arthroplasties at several centres in Great Britain. She found that, amongst the mould arthroplasties which had been performed 1, 2, 3, and 4 years before, the number of poor results was nearly constant at 30 per cent; amongst those which had been done for 5 years or more, there were over 50 per cent of poor results. Acrylic replacement arthroplasties showed 25 per cent of poor results at 1 year, 30 per cent at 2 years, and 38 per cent at 3 years. The findings in a further survey of these same patients that is now in progress are awaited with great interest.

There is a fundamental difference between the Smith-Petersen mould arthroplasty and the replacement procedures. The mould floats freely between the re-fashioned bony surfaces, the intention being to hold them apart whilst they become re-covered with fibrous or cartilaginous tissues. Its function has been regarded as physiological rather than mechanical, but whether this is so or not, it is now clear that the reaction of the body, perhaps not so much to the pressure of the mould as to the somewhat crude attempts of the surgeon to fashion a new joint, is such that the result is not durable. The prosthesis, on the other hand, has a mechanical rather than a physiological function. It is intended to replace a part of the bone that has been excised;

FIG. 563.—McMurray's subtrochanteric osteotomy with internal fixation by a trifin nail and plate (Nissen's modification).

it is attached to bone and must remain securely attached for the rest of the patient's life. But bone is not an inert substance, it is living; it reacts to the new stresses placed upon it and it continues to react for as long as they are present. Like a house built without foundations, a prosthesis fastened to bone must fall in time. A replacement arthroplasty is therefore hard to justify except in the elderly. In younger people, should it be necessary to re-fashion the joint, a mould arthroplasty is still the best operation available.

The inevitable difficulties and uncertainties of arthroplasty have increased the popularity, at any rate in Great Britain, of two older procedures—McMurray's intertrochanteric osteotomy, and excision of the head and neck of the femur as advocated by the late G. R. Girdlestone.

INTERTROCHANTERIC (DISPLACEMENT) OSTEOTOMY

A few surgeons have remained faithful to this operation since its introduction, but it has only recently come into general use. Interest was stimulated by a paper by Osborne and Fahrni (1950), who re-examined 75 patients operated upon by the late T. P. McMurray and his colleagues from one to twelve years earlier. They found that 80 per cent

were nearly or completely relieved of pain and in only a few was movement markedly reduced. Pain had not returned with the passing of time.

The operation as originally performed consisted in an osteotomy of the femur sloping obliquely upwards and inwards at an angle of about 40° and terminating just above the lesser trochanter. The lower fragment was displaced inwards so that its inner point lay below the acetabulum, thus restricting adduction. McMurray immobilized the patient in a plaster-of-Paris spica whilst the osteotomy was

FIG. 564.—Excision of the head and neck of the femur with a Batchelor osteotomy. The leg is rotated outwards, making the angle between the trochanters and the shaft appear less than is the case.

uniting, but the common practice now is to rely upon some form of internal fixation (*Fig.* 563).

The reason why osteotomy should so often give relief from pain, apparently for very many years, has not been satisfactorily explained. Amongst the suggestions are :—

1. The head of the femur gradually rotates to the position in which the capsule is most relaxed, thus relieving tension—but success also follows internal fixation of the osteotomy when gradual rotation is prevented.

2. The changed position of the femoral head re-alines the stresses within the hone—but then the pain should return when the bone has become adapted to the changed conditions.

3. The inner angle of the lower fragment abuts against the acetabulum and prevents adduction—but relief often follows osteotomy with little or no displacement.

4. Interruption of the medullary blood-supply to the head of the femur arrests or slows the progress of the arthritis.

Whatever the explanation, subsequent series have shown a comparable number of successes. A fair assessment of the results is that half the patients lose nearly all their pain, and a third lose much of it. Those not relieved of pain apparently are made no worse. The operation seems to be so entirely irrational that surgeons have been slow in accepting it, but now that many good and lasting results have been reported it is being used more and more.

EXCISION OF THE HEAD AND NECK OF THE FEMUR

Excision of the head and neck of the femur was advocated by the late G. R. Girdlestone, but, although he had learnt it from Robert Jones and had practised it on occasion for many years, his views were not published until 1945. The procedure certainly removes the actual cause of pain, but it does so at the price of stability. Batchelor (1948), in an attempt to improve stability, recommended that an abduction osteotomy of the femur below the lesser trochanter should be performed as well (*Fig.* 564). This modification increases both the severity of the operation and the subsequent period of immobilization ; its advantages do not strikingly outweigh its disadvantages. A simple excision of this type is practised not infrequently after a prosthesis has failed, and also to obtain movement when there is bilateral ankylosis of the hips as in Still's disease and ankylosing spondylitis. A weight-relieving calliper may be necessary at first, but the new scar tissue forming around the pseudo-arthrosis usually becomes strong enough within three to six months to enable it to be dispensed with. A usual result is a comparatively painless and movable hip which permits sitting in comfort and walking a fair distance, but with a Trendelenburg gait and the aid of one stick.

ARTHRODESIS

The most certain way of getting rid of pain at a joint is to fuse it, because when there is no movement whatsoever there can no longer be pain. The price that must be paid for a stiff hip can be discussed in terms of function and this varies with the age of the patient, his occupation, and the condition of other joints, particularly those of the spine and the knees. The major functions of the hip are :—

Involving progression { walking / climbing

Relatively static { sitting / riding / bending / regulation of posture

Walking : The movements of the hips when walking are subtly adjusted in such a way as to ensure that the path followed by the centre of gravity of the body is as straight as possible, and any divergence from this path increases the expenditure of energy (Saunders, Inman, and Eberhart, 1953). Walking on level ground involves not only the major movements of flexion and extension of the hips, but also internal and external rotation, adduction, and abduction at every step. Loss of flexion and extension can be compensated almost completely by movement at the opposite hip, loss of abduction or adduction can be adjusted by flexing one or other

knee, but loss of rotation cannot be compensated. A person with a stiff hip therefore walks with only a very slight limp, but he uses rather more energy.

Climbing: Walking up a gentle incline is not difficult, but, since the glutei are no longer available to help lift the body, the work has to be done by the quadriceps alone. Going up a steep hill or going upstairs in the ordinary way may be impossible, although it can be accomplished by leading with the sound leg at each step.

Sitting: Loss of flexion cannot be compensated at the opposite hip, but it can be to a considerable extent at the lumbar spine, provided the spine is normal. A supple spine permits nearly 90° of flexion; this enables a reasonable sitting posture to be adopted, although at the price of some strain on the intervertebral joints and ligaments. Older people usually have a smaller range of movements at the spine and after arthrodesis sitting upright is correspondingly difficult, but it can be managed by sitting at the edge of the chair. The disability is really grave only for those races who customarily squat on the heels, and for those people whose religious observances call for ritual prostration.

Riding, perhaps less important than it was at one time, is possible if only one hip is stiff, but it does mean rather an ugly saddle with a long stirrup on the affected side. Bicycling is usually impossible. Sexual intercourse and parturition, also functions that commonly involve abduction of the hips, are sometimes said to be interfered with, but many women with a stiff hip have both conceived and borne children in the natural way.

Bending or stooping to the ground is ordinarily carried out by a combination of movements at the knees, the hips, and the spine. A young person with a flexible spine and one hip fixed in 20° of flexion can usually bend forwards to do up his own shoelaces. Gardeners, even elderly ones, manage to work with their hands at ground level by flexing the opposite knee and hip whilst the affected leg sticks out behind.

Regulation of posture: The curve of the lumbar spine when standing erect depends upon the inclination of the pelvis and this is determined by the position of the hip-joints. A fixed deformity of the hip modifies the position of the pelvis, but this can be compensated within wide limits by a supple spine. A stiff spine is, however, unable to do so and then, if the deformity of the hip is severe, standing and walking are difficult.

It is clear that those actions involving progression are interfered with less seriously than those which are comparatively static. A stiff hip therefore tends to be a smaller handicap to the young than to the old because the elderly spend more time sitting (but the occasion of this special number of the JOURNAL calls for notice of a pertinent exception to this generalization!). A young person with a painful hip is usually pleased to exchange it for a painless but stiff one. A girl of 20 who had had several previous operations on her hip, including a mould arthroplasty, wrote, a year after it had been fixed by arthrodesis: "For the first time in my life I am able to lead a normal life like other young people."

Since reasonable function is assured for as long as other joints remain supple, it is not surprising that arthrodesis received early attention from surgeons. The first arthrodeses were performed to stabilize flail joints resulting from infantile paralysis. The scope of the operation was later extended to the treatment of tuberculous disease, the idea being

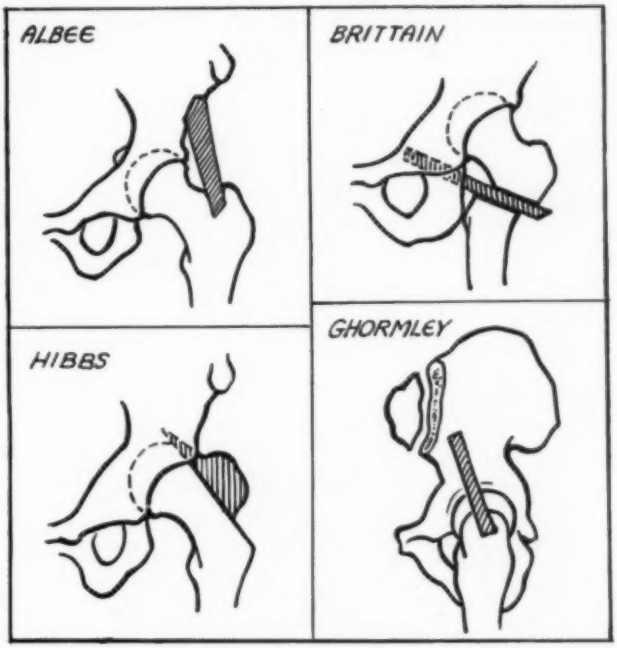


FIG. 565.—Types of arthrodesis.

to place the joint at rest without the necessity for prolonged recumbency. Arthrodesis of the hip, to avoid interfering with the diseased area, was by means of an extra-articular, iliofemoral graft. This could not correct deformity, and the graft often failed to fuse at the lower end because the femur was pulled away by the predominating power of the adductors and the adducting force of bearing weight. For the treatment of osteo-arthritis, intra-articular methods were developed. These for the most part consisted in removing the articular cartilage and eburnated bone from both surfaces of the joint followed by prolonged immobilization in a double plaster-of-Paris spica. It was a formidable procedure, and as recently as 1929 Robert Jones, in the standard text-book of the day, relegated the operation to small type and described it as "a fairly severe test of endurance of the patient".

Very many different types of arthrodesis have since been described, some intra-articular and some extra-articular. Most of them, for example those of Albee, of Ghormley, and of Hibbs (*Fig.* 565), made use of iliofemoral grafts; they often failed because of the tendency of the hip to adduct. Brittain (1942) overcame this difficulty by adapting Trumble's ischiofemoral arthrodesis in such a way that adduction compressed the graft and therefore assisted fusion. However, this operation, like the others, was necessarily followed by prolonged recumbency in a plaster spica.

The next step followed naturally on the development of the technique for the internal fixation of

transcervical fractures of the neck of the femur by Smith-Petersen and Sven Johannsen in the late nineteen-twenties and early thirties. The obvious thing was to drive a trifin nail across the joint into the ilium in the hope that it would resist the adducting forces acting on the joint. The first occasion on which the author attempted this, after excising the

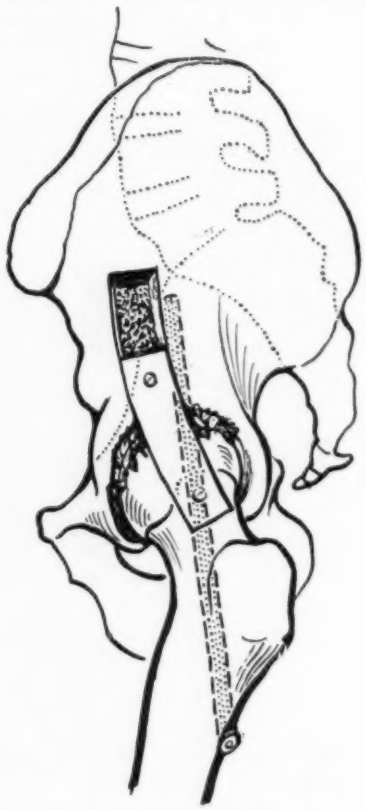


FIG. 566.—Wiles's arthrodesis.

joint, was in 1933, and he has used the method, or a modification of it, ever since. The operation was developed independently by Burns (1936), and also by Watson-Jones (1938), who had an extra long and strong trifin nail made especially for the purpose. The advantage of internal fixation is that it facilitates fusion by preventing adduction and nearly abolishing all other movement between the raw bony surfaces. The bone, however, reacts in the ordinary way to the presence of metal under stress and undergoes absorption. A trifin nail is therefore unable to fix a joint indefinitely, but it does immobilize it for long enough to enable cancellous bony surfaces to fuse.

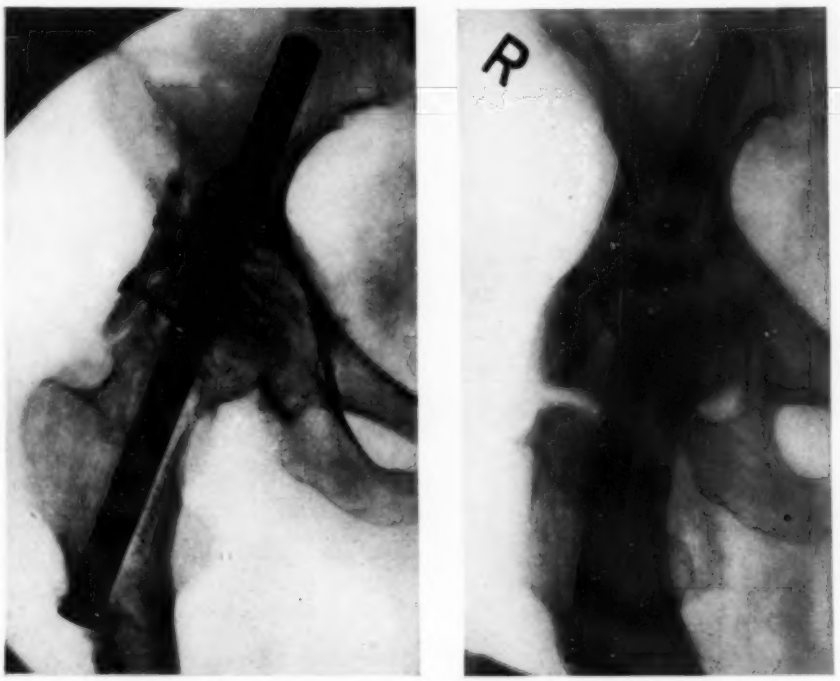
The author's operation is intended firstly to promote fusion by bringing large areas of cancellous bone into close apposition, secondly to incorporate a graft including cortical bone which quickly thickens to give strength, and thirdly to prevent movement by means of internal fixation whilst fusion is taking place (*Fig.* 566). To this end the articular cartilage and cortical bone are removed from the head of the femur and acetabulum, preferably after dislocating the hip, but if necessary without doing so. A graft is cut from the outer table of the concavity of the ilium where the curve allows it to be moved downwards to overlap the neck of the femur. This both increases the area of cancellous bone in apposition and provides cortical bone. Internal fixation is by means of a Watson-Jones trifin nail driven through the neck of the femur into the ilium. The nail prevents abduction and adduction until union has occurred. It does not, however, give any good protection against flexion because the outer, cortical surface of the shaft of the femur is splintered when the nail is introduced, the almost hollow neck gives it no support, and there is only the cancellous and possibly cystic head to prevent the femur rotating around the long axis of the nail. A short plaster-of-Paris spica is therefore applied for additional security in most cases. The spica need not, as a rule, extend below the knee, hence it does not cause stiffness of that joint, nor does it prevent the patient from being lifted into a chair soon after operation, or from walking after a few weeks.

The details of the operation are varied according to the age and general condition of the patient, and the condition of the bone. Very few people are too frail to be subjected to a modified form. With a young and healthy patient the hip is approached by Smith-Petersen's route and dislocated. The articular cartilage and cortical bone are removed from both surfaces of the joint with hemispherical burrs of the type used for arthroplasty. The limb is then alined and a trifin nail is introduced through a separate lateral incision. The nail is placed obliquely to give contact with the dense cortical bone of the under surface of the neck, and it should reach nearly to the sacro-iliac joint. A hole is first made in the femur at a point about 1½ in. below the digital fossa and then a guide wire mounted on an electric drill is passed through it. It will be found in patients of almost any shape that, if the guide is pointed exactly in the direction of the umbilicus, it will nearly always be properly placed. Direction in the horizontal plane is obtained by feel as the guide passes through the neck, and only an anteroposterior check radiograph should be necessary. Care must be taken to ensure that the raw surfaces do not become separated when the nail is driven home, and should this occur it must be rectified by driving the femur along the nail with an impactor. An iliac graft about 3 in. long and 1 in. broad is next marked out and lifted with an osteotome curved on the flat. The graft is secured either by two screws or by impacting the lower end in a notch cut obliquely in the neck of the femur. The final stage is to cut slots across the junction of the femur and the pelvis and pack these, and also any gaps caused by incongruity between the head of the femur and the acetabulum, with cancellous bone from the ilium and any chips already removed. A short plaster spica can be applied at once, or this may be delayed for two or three days.

The operation is modified for elderly people. The hip is not dislocated and any deformity that cannot be corrected under the anæsthetic has to be accepted. The whole procedure need not take longer than three-quarters of an hour, and it can be carried out in two stages if desirable. The trifin nail is first introduced through a lateral incision. The hip is then exposed and the anterior, superior,

and posterior aspects of the joint are excised with a curved osteotome. The space thus produced, which is about ¾ in. deep, is packed with cancellous bone driven in with a spare punch, and an iliac graft is cut and fixed as before.

Thirty-nine operations of this type have been performed at the Middlesex Hospital since the war. In 6 there was no external fixation, in 25 a short spica was worn for six to eight weeks, and in 8 a long spica was applied for four to eight weeks, sometimes followed by a short spica. All patients except those in long spicas were lifted into chairs after a few days. Weight-bearing was begun an average of four weeks after operation; on only 4 occasions was it delayed for six weeks or longer. Fusion occurred in every patient except 1, a man from South Africa who subsequently underwent a further operation in Johannesburg. The time elapsing before sound union had occurred cannot be estimated accurately because of the difficulty in interpreting the radiological appearances (*Fig.* 567 A).



A B

FIG. 567.—A, Wiles's arthrodesis without dislocating the joint after 3 months. The hip felt secure and there was no pain. B, Five years later the graft was well consolidated. The patient fell and broke both the neck of the femur and the nail.

The only complication resulting immediately from operation was a rotation fracture of the neck of the femur caused by the careless lifting of the patient from the table at the conclusion of operation but before a plaster had been applied. The arthrodesis of course united very quickly, but the fracture failed to do so until after a bone-graft had been inserted. On one occasion the trifin nail broke before fusion had occurred, but this was not long delayed. The late complications were all caused by falls some years after operation, when 2 patients sustained subtrochanteric fractures at the level of insertion of the nail, and 3 had transcervical fractures, the nail fracturing at the same time (*Fig.* 567 B). It seems that the nail takes the 'whip' out of the neck of the femur, making fracture more likely. Removal of the nail as soon as there is secure bony ankylosis is now considered desirable in younger patients.

INDICATIONS FOR OPERATION

The object of operation is not to cure disease but to relieve symptoms. These may be three—pain, deformity, and stiffness. Deformity and stiffness unaccompanied by pain very seldom call for surgery, and pain, at the present stage of surgical development, is virtually the only indication. No operation gives a perfect result and it is only too easy to make the patient worse. It is, therefore, essential to be sure that the condition, as judged in terms of both pain and function, is so bad before operation that it may reasonably be expected to be much better afterwards. The patient has seldom enough knowledge of end-results to make the decision himself, and it has usually to be undertaken by the surgeon who has therefore to assess the severity of the patient's pain, not always an easy matter. No mistake can be made about pain that is intolerable, pain that prevents almost all activity by day and interferes with sleep at night, pain that makes life no longer worth living. It is less easy to assess pain of the intermediate grades, particularly in people who find it difficult to express themselves. It may have to be judged in terms of function—how are stairs negotiated? Can the shopping basket be carried in the hand on the same side as the affected hip? Is there pain at rest and is sleep disturbed? The radiological appearance gives no indication of the amount of pain or the extent of interference with function. Some dreadful looking hips do not hurt at all, whilst others with but little visible change are very painful.

The severity of pain calling for operation varies with age and occupation. An older person can more readily adjust his life to moderate pain and avoid those activities that produce it. But a young adult who is prevented by pain from leading a normal life and doing the same things as other young people is seriously handicapped.

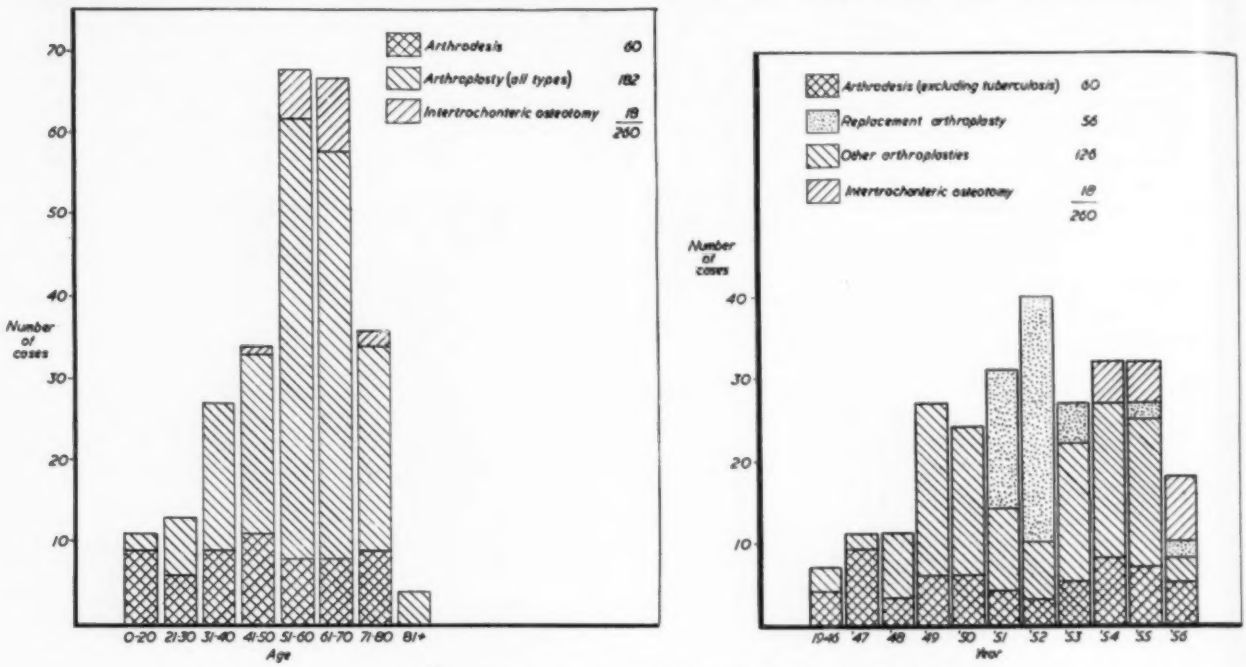


FIG. 568.—Operations on the painful hip at the Middlesex Hospital.

CHOICE OF OPERATION

Some idea of the changing fashions is given by a review of the work at the Middlesex Hospital (*Fig.* 568). Since the war a total of 260 operations has been performed for painful hips, mainly due to osteo-arthritis, in patients in the care of my colleague, Mr. Philip Newman, and myself. The number of arthrodeses is 60, excluding those for tuberculous disease. The number remained much the same in each year throughout the period, with a slight lapse during the brief phase of replacement arthroplasty. There is also a remarkably even distribution at the different ages.

Mould arthroplasty was developed during the war whilst we were both in the Army, and at first our approach was cautious, but subsequently the number remained fairly constant at 25–30 a year. ' Other arthroplasties ' are nearly all Smith-Petersen's mould arthroplasties, which stayed in favour until it became apparent that the results were not as durable as was thought at one time. There was an unfortunate period during 1951, 1952, and 1953 when we succumbed to the temptation of trying replacement arthroplasty of the Judet type because of the brilliant early results. The replacement arthroplasties performed in 1955 and 1956 were attempts to salve failed Judet arthroplasties by means of a Thompson prosthesis. The drop in the number of all operations in 1956 was due to the discouragement of the experience of earlier years. Intertrochanteric osteotomy has since gained ground and it is interesting to notice that the number performed during 1957 is 3 times as many as in 1956.

At the present time, when pain is of such severity as to justify operation, there is a choice of three procedures—arthroplasty, displacement osteotomy, and arthrodesis. The advantages and disadvantages of each are shown in *Table I.*

Table I.—A COMPARISON OF THE OPERATIONS FOR OSTEO-ARTHRITIS OF THE HIP

	MOULD ARTHROPLASTY	OSTEOTOMY	ARTHRODESIS
Pain	Relieved in ½, reduced in ¼	Relieved in ½, reduced in ¼	Relieved in all
Deformity	Usually corrected	Often corrected	Usually corrected
Stiffness	Reduced in most	Unchanged in most	Increased in all
Function: Walking	Good in ½ Fair in ¼	Improved in the ¾ with reduced pain	Usually good
Static	Good in ½ Fair in ¼		Much impaired
Durability	Uncertain, say 5–10 yr.	Apparently permanent	Permanent
Strain on spine	Unchanged or reduced	Unchanged	Increased

The position is that :—

Mould arthroplasty relieves or reduces pain, reduces stiffness, and gives acceptable function in nearly three-quarters of all patients. The durability is, however, uncertain and a young person is faced with the prospect of repeated operations of increasing difficulty.

Osteotomy relieves pain in a similar number but it improves mobility and function only in so far as improvement comes from reduction in pain. The very long-term results of the operation in young adults are not known, but in older people they appear to be durable.

Arthrodesis always relieves pain at the hip but only at the price of a stiff joint. Walking is satisfactory, but sitting and stooping are interfered with. The result is permanent, but strain on the spine is increased and this may eventually lead to pain in the back.

The final choice of operation depends on the age of the patient, on the range of movements at his hips and spine, and on his occupation and his temperament. There can be no doubt that in *children* and *young adults* with a normal spine, say in those under 40 years, arthrodesis gives the best results. It permits an almost normal life without the awful prospect of further major surgery followed by long periods of rehabilitation. In *middle-aged* and somewhat older people who have a good range of flexion at the hip intertrochanteric osteotomy seems at present to offer the best prospect of lasting relief from pain without serious interference with function. However, when the hip is stiff and the spine is good, arthrodesis gives a better and quicker result. But with a stiff hip and a spine that is already undergoing progressive degenerative changes, arthroplasty is desirable because it improves movement and thereby relieves the strain on the spine. The Smith-Petersen operation is the best at this age. Should the pain unfortunately return after a number of years, the 'working stock' has been preserved and some further procedure is still possible. In the *elderly* and the old, say those over 70, a replacement arthroplasty of the Thompson type gives a quicker result and it may reasonably be expected to outlast the patient.

There is a place for arthrodesis at every age. When deciding on the relative merits of arthrodesis and arthroplasty for an older patient, it must be remembered that, if a modern technique is used, arthrodesis is not a severe procedure and the convalescence is short. Arthroplasty does not reach its best for many months and it calls for a certain hardihood and emotional stability to endure the long period of rehabilitation. Older people of a more impatient or a more exacting nature, provided there is virtually no movement at the hip, may be better pleased by arthrodesis.

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SECONDARY SURGICAL INTERVENTION

BY JULIAN ORM SMITH, MELBOURNE

THE Roman Empire had declined and fallen centuries before the narrator of those remarkable series of revolutions submitted to the will of his surgeon, Henry Cline, who tapped his hydrocele. A prodigious quantity of fluid was withdrawn, yet the size of the swelling was merely reduced. Here was the warning note. Nevertheless, within a few weeks Mr. Cline decided that he should intervene. Two days later Edward Gibbon was dead.

Queen Victoria was suffering from a painful swelling in the axilla. Joseph Lister incised the abscess, inserted a drainage tube, and dressed the wound. He left the Palace and then, as he was driving along the Mall, suddenly he tapped his coachman on the shoulder and ordered him to turn back. Lister was again announced and sought permission to see his august patient. Despite the short time that had passed since the comparatively minor operation which he had performed, he felt that he must intervene. He had neglected to insert a safety pin through the drainage tube!

These stories—the one tragic, the other fanciful—may serve to promote the theme of this short contribution, which, within a very limited sphere, is concerned with post-operative complications.

As I see it, the main purpose of surgical writing should really be to provide instruction. I trust therefore that I will not be judged as overstepping the bounds of becoming reticence, if I entertain the hope that some of my arguments may appeal to young surgeons who may have had less experience than has been apportioned to me. But at the same time, having regard to the nature of the problems upon which I will dwell, I cannot restrain a rather uncompassionate feeling of satisfaction in anticipating the mood of my contemporaries when they may recall to mind the occasions when they suffered similar surgical anxieties.

A young surgeon can be faced with no greater dilemma than at the time when he is forced to make decisions concerning a patient whose post-operative course is irregular. His disquietude may no doubt be increased if the operation has been one of election. A formal surgical procedure has been completed *secundum artem*. The patient's relatives and friends have been informed that all will be well. And then, either from insidious clinical signs, or from others which may be alarming, it is obvious that something is amiss. At this juncture it is idle for the surgeon to reason in retrospect on the basis of a sound operation.

His surgical judgement is now at a premium; pride and sentiment are at a discount. Neither at such a time can the feelings of the patient or the relatives be spared. Nevertheless the decision to intervene in what might be termed a blended family atmosphere, for a time charged with confidence but of a sudden filled with doubt, is a hard one to make. But, at times, action is imperative. The patient may be going downhill and, with delay, thereafter the gradient is steep. "The procrastinating man is ever struggling with ruin."

In these days the expanse of operative surgery is vast. The palisades, both structural and functional, beyond which the human body can contain the surgeon in his intrusions, attempting to correct its malformations or cure the ills which beset it, are becoming less and less obstructive. Surgical invasions to a degree undreamt of by John Erichsen have now become matters of day-to-day technical routine.*

It would serve no purpose to discuss these radical and somewhat daring surgical innovations which my colleagues in the sheltered specialties practise with distinction. Rather am I briefly concerned with the exigencies which may compel the general surgeon to intervene after he has performed a comparatively simple abdominal operation of long usage and established pattern.

1. PARTIAL GASTRECTOMY

There are many complications which may follow partial gastrectomy (i.e., the several modifications of the Billroth II operation) for peptic ulcer, but of these, two in particular always demand forceful attention.

a. **The Leaking Duodenal Stump.**—A somewhat distant surgical acquaintance once said to me that never had he to contend with a leaking duodenal stump. As his experience, by repute, was quite extensive, this remark was so provoking that I at once turned the conversation into other channels which I thought would, in the end, prove to be more agreeable. Any surgeon who performs partial gastrectomy for peptic ulcer often enough, will eventually have to cope with the leaking stump. The reports of so many eminent surgeons who drain the region of the stump as a precautionary measure should provide adequate testimony to this submission. This is not the occasion to give full consideration and argument to the possible causes of this post-operative mishap. It is improbable that a single causal factor can be held responsible in every patient in whom it occurs. Perhaps the most unlikely overall explanation is that the stump has been closed inefficiently. Who of you with experience in this matter can deny the fact that, on occasions, the most perfectly closed stump will blow, and on the other hand, the ones about which you are apprehensive remain secure?

One might be apt to think that the clinical signs of the leaking stump would be similar to those of a perforated duodenal ulcer. This, of course, is not so. In my experience the clinical manifestations of the leaking stump have been insidious and not dramatic. Abdominal pain has not been an outstanding feature. Perhaps the earliest signs which have been observed are an increase in the pulse-rate and tenderness in the right side of the abdomen; and although we are always vigilant, I suspect that by the time we decide to operate, the leak has been of longer duration than we think, and by then there is nearly always some abdominal distension.

However, with regard to this matter I have quite recently been aroused by my colleague Douglas Leslie, and I am indebted to him for permitting me to quote from his observations. Within a short period he had the experience of dealing with two patients who presented an almost identical clinical picture after gastrectomy for duodenal ulcer—a clinical picture as remarkable as it is suggestive. Briefly, on the third or fourth post-operative day these two patients complained of severe upper abdominal pain for which morphine afforded little relief. At the same time both patients were in a state of 'collapse'. My friend, in his wisdom, rejected on both occasions the diagnosis of coronary occlusion (surely this surgical alibi has worn a little thin by now!), and decided that he should re-open the abdomen. On separate occasions with these two patients anæsthetized and relaxed on the operating table, there was an obvious transverse balloon-like swelling in the epigastrium. This proved to be a tense dilatation of the entire duodenum, extending from the infolded stump, which was still intact, to the duodenojejunal flexure, at which point the distension abruptly gave way to the afferent loop, which, as Leslie said, "was so innocent that it was literally flapping in the wind". I leave it to my colleague to describe his experiences with these patients more fully and to recount elsewhere the ingenious device which he employed in relieving them. Surely the evidence which these two patients provide might suggest a clue to the solution of the leaking stump which so far has remained elusive.

For the purpose of immediate discussion it is assumed that a diagnosis of a leaking stump has been made. The abdomen must be re-opened—how? The surgeon may think he has some selection in this matter. He has no choice at all. The original incision must be undone. Now, if the transrectal incision was the one through which the gastrectomy was performed, the surgeon is at the cross-roads indeed. He certainly has a job on his hands! This transrectal incision is nothing less than a surgical mutilation born out of fear of inadequate exposure. It is unnecessarily time-consuming both in its construction (? destruction) and restoration. Again, the original incision may have been made through the right paramedian area. Then with the complication of the leaking stump, the unwary may reason that a Kocher incision might provide the best access to the site of the leak. And so it would—but only at the

* "An art may be modified—it may be varied—but it cannot be perfected beyond certain attainable limits. And so it is, and indeed must be, with that of surgery. There cannot always be fresh fields for conquest by the knife. There must be portions of the human frame that will ever remain sacred from its intrusion—at least in the surgeon's hand. That we have already nearly, if not quite, reached these final limits there can be little question. . . . To my mind it appears as if we had already reached something like finality in the mere manipulative art of surgery." (Written in 1884.)

cost of breakdown of the original wound. This may seem to be very obvious, but I have witnessed such a sequence of events.

The leaking stump does not, of course, lend itself to repair. Often, the actual site cannot be found. There is a mushy, greenish, fibrinous exudate in the area which only a few days before had been, apparently, a snug and clean closure. A stab is made in the flank. The pelvis is explored with a swab on a holder. If it is withdrawn soaked, and with an abundance of fibrin, a suprapubic stab is made and the pelvis drained. The drainage tube in the flank is attached to underwater suction as soon as the patient returns to the ward. The suction is maintained until there is a ' nil return ', but the drainage tube is retained for a further 48 hours. All of this, of course, is but token advice. It is no contribution to the problem of the leaking stump.

But in extenuation I have this to add: My colleagues and myself, and all of our young assistants whose surgical hands we hold from time to time, are all gastrectomy minded. Collectively, we have performed some thousands of these operations. In the year 1957 we are not just learning the rudiments of this surgical procedure. But still, some of our patients die because of the leaking stump. This is a subject well worth a wholesale inquiry, and we have this purpose in mind. It seems to me to be obvious that technical faults are always responsible for this surgical disaster, but it is proper to suggest that such technical faults may have been born out of errors of surgical judgement. For my part, I am not so eager as I was at one time about the dissection of the first part of the duodenum. " Removal of the duodenal ulcer " has never been a part of the operation which I perform. I will have no truck with the Bancroft operation. I remove all the antrum, despite the difficulties which subsequently may follow. I have no doubt that, in order to secure a good closure of the stump, there are surgeons who find it a technical convenience to divide the stomach *just a little* to the left of the vein of Mayo. And in the final assessment of things, who at this stage can deny that perhaps they may be proved to be right?

b. **Anastomotic Ulcer.**—Any attempt to undertake even a moderate review of this contentious subject would be far beyond the scope of this paper. At the same time it may be argued that any discussion of anastomotic ulcer may seem to lack that nature of urgency which the title of this paper might suggest in the matter of time. Nevertheless, anastomotic ulcer following gastrectomy for duodenal ulcer may demand the most urgent attention.

The following argument may appear obtuse, and perhaps highly speculative; and although it is based numerically on an experience which is trifling, it is to me highly suggestive. In the 1920's Hugh Devine described his ' exclusion ' operation for duodenal ulcer. Now, I saw him at work; I assisted him; he was a great technical surgeon who could deal with most things in the abdomen. But when operating on some patients with duodenal ulcer he came face to face, more than once, with a large strawberry-coloured, angry-looking mass in the pyloric region—the gall-bladder, liver, pancreas, and perhaps the common bile duct being involved. He found something which if attacked in the orthodox manner would set the Polya operation outside the limits of safety, Very wisely he ran for cover. He divided the stomach a little above the angularis, infolded the antrum, and performed a Billroth II type of anastomosis. He had, without risk, effected a secure distal closure.

Surgeons the world over were only too happy to follow his lead—for a time. Then the Devine operation became the subject of odium because of the

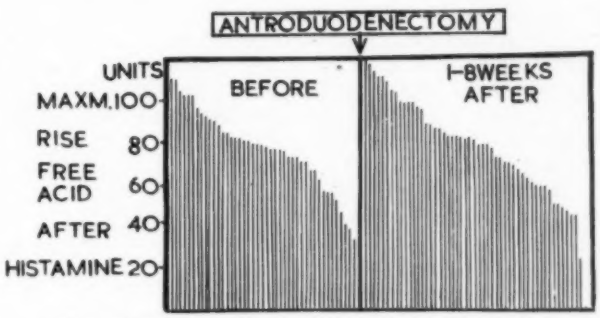

FIG. 569.—Fifty-one patients subjected to antroduodenectomy for duodenal ulcer showing maximum rise in Free Acid in histamine test-meal. Owing to their clinical condition, 8 patients did not have a pre-operative meal. After 8 weeks some patients showed a fall in acid, possibly due to post-operative gastritis. (*After Brown and Wood.*)

frequency with which jejunal ulcer followed. There were many who affirmed that such a complication could be expected because the pyloric antrum had not been removed. These critics invoked doubtful physiological dogma based on animal experiments, and it was reasoned that, as the antrum produced gastrin, the retention of this part of the stomach would be bound to maintain hypersecretion of acid in the body of the stomach after the exclusion operation in the human subject. Concerning this matter, I have heard second-hand at the best, that someone or other, having had to deal with this problem, had operated, removed the antrum, and the anastomotic ulcer had healed! I would treasure a personal communication from any surgeon who has enjoyed such a fortunate experience. I doubt whether any of these replies, should they be received, would be able to withstand close scrutiny.

There can be no doubt that anastomotic ulcer following the exclusion operation, or the Polya procedure, is due to the action of acid upon the jejunal mucosa. But why blame the retained antrum in the first instance! I am not concerned with dogs or any other experimental animal, but *in a man who has a duodenal ulcer, the removal of the antrum has little effect in lowering gastric acidity* (Brown and Wood, 1955) (*Fig.* 569). What may be the explanation of these discrepancies? The imprudent surgeon will from time to time be confronted with the large red, angry-looking, pyloric mass. Under such circumstances it is held that the exclusion operation should be shunned because of its sinister reputation. So the surgeon, enjoying, as he does, good anæsthesia, relaxants, and antibiotics, sets to work, and to his credit unravels the tangle and performs a subtotal gastrectomy. But still anastomotic ulcer may follow. Why?

The natural history of duodenal ulcer is one of exacerbations and remissions of activity. The large,

red, pyloric mass obviously suggests that the ulcer diathesis (whatever this may be) is on the crest of a wave of activity. It is not only the ulcer and the structures which touch upon it that are angry-looking and red. I feel sure that at the same time the gastric mucosa is like a flaming cauldron, bubbling with acid to an unnatural degree. If, then, the jejunal mucosa is bared to the gastric juice, it is bound to suffer. As I have said, all of this may be purely conjecture, but at least it rests in my mind, on the basis of clinical observations recalled from the past.

Many years ago I assisted my father at an operation on a prominent man whose ulcer pain was really intense. Operation revealed the large red mass—the gall-bladder and liver being involved. The exclusion operation was performed. The patient died 12 weeks later following a resection of the gastrojejunocolic fistula which had formed within so short a time.

Perhaps I should submit something more substantial for the purpose of forcing my argument. The evidence is provided by four patients* who developed jejunal ulceration following an adequate Polya-Balfour partial gastrectomy. All of these patients were operated on when they were suffering great pain, and the large red pyloric mass was there in every one of them. I am perfectly convinced that all of these patients developed anastomotic ulceration within a few weeks of the operation of partial gastrectomy. There was early post-operative recurrence of pain in all of them. One man, no doubt dissatisfied with my attempt to cure him, sought sanctuary in another hospital, where, because of alarming loss of weight, he was eventually admitted to the tuberculosis ward for assessment. Suddenly his jejunal ulcer bled and perforated at the same time. He had of course developed a gastrocolic fistula and he died 14 weeks after the operation which I had performed for his duodenal ulcer. The other patients conformed to a somewhat similar pattern, but fortunately there was a happier result in all of them. What is the answer? I have a very firm mind on this matter. I will never again operate on a patient who has a duodenal ulcer if, or because, he is suffering great pain. It is up to the physician to alleviate this pain and keep it subdued for some time before, in my book, the patient is a fair surgical risk. When this object has been achieved, operation may be undertaken, confident that no large, red, angry-looking pyloric mass will be revealed, and partial gastrectomy may be performed with one's mind relatively at ease concerning the possibility of the awful complication of anastomotic ulcer. Furthermore I would suggest that, if quite soon after partial gastrectomy for duodenal ulcer the patient complains of pain, it must be assumed that an anastomotic ulcer has developed, and every effort must be made to establish the diagnosis (strange as this may seem!) because under these circumstances a transthoracic vagotomy cannot be performed too soon.

I sense that to-day the surgical approach to peptic ulcer is becoming a little more cautious, for obvious reasons. Gastric ulcer, a degenerative lesion, lends itself to almost certain relief by the Billroth I operation, and there are few complications. However, we may be surprised to find how many of these patients of ours whose gastric ulcers were successfully treated are dead from causes quite unrelated to the operation, and within a few years.

Fortunately all the best people do not have peptic ulcer, and if there were any truth in the suggestion to the contrary, our surgical life would be intolerable. In the case of duodenal ulcer we are still faced with many problems. There is the wisdom, even the cunning, to be manifested in the selection of patients for operation. There are the post-operative complications demanding secondary intervention—the leaking stump, loop trouble, and this anastomotic ulceration; and at a later period the severe dumping syndrome, the non-thriving gastrectomy to the point of inanition, and those occasional patients who develop gross steatorrhœa. I do not for a moment believe that one and all of these sequelæ are the result of a bad gastrectomy. Might it not be rather that partial gastrectomy for duodenal ulcer is an unsound operation? Of course the complications of duodenal ulcer will always demand urgent surgical attention when they occur. On the other hand, I feel sure, and I hope indeed, that many of my young surgical friends will live to see the day when partial gastrectomy for uncomplicated duodenal ulcer will be regarded as an obsolete operation.

2. CHOLECYSTECTOMY

In Australia cholecystectomy is unfortunately regarded as a simple affair. Most of our people are so well fed, and indeed so overnourished, that a comparison of the incidence of gall-stones in this country with the United Kingdom will lend the strongest support to the view that cholelithiasis is merely the result of metabolic disorder. Therefore in Australia there is abundant material upon which surgeons—qualified and unqualified—can set to work. Secondary operations may be demanded for many reasons after cholecystectomy, but there are three conditions which stand out from the others in sharp relief: (*a*) Injury to the bile-ducts; (*b*) Biliary extravasation; (*c*) The post-cholecystectomy syndrome.

a. **Injury to the Bile-ducts.**—When jaundice appears shortly after cholecystectomy, it is an ominous sign and almost certainly denotes that there has been some injury, either to the common hepatic or common bile-duct. Here, again, the question of repair and the methods adopted to achieve this end will not be considered. It may well be asked, Why then, does this subject come up for discussion at all? My licence to do so was obtained by visiting the College library, where I recently examined an expansive, expensive, and well-produced volume on operative surgery, published in 1957. Turning to the pages which illustrated cholecystectomy, there were the long curved forceps gripping the cystic duct—all the anatomy admirably displayed in glossy text-book fashion!

It is no disgrace to find that at times we could with advantage reconsider some of the basic principles of operative surgery. It is a disgrace if we deny that a return to such fundamentals is never required.

* It is not suggested that these are the only patients who developed jejunal ulcer after partial gastrectomy at my hands. Doubtless there are others who subsequently went elsewhere for help.

The ensuing argument is not one which merely revolves around the surgical implements which were designed by Moynihan and MacCormick* respectively. Rather is it concerned with a principle of operative surgery, the violation of which is responsible for nearly every case in which there has been injury to the common bile-duct during cholecystectomy.

The principle is this—ligature of any duct or blood-vessel of importance should be performed in continuity, and not after division over forceps. The main fact in support of this principle is quite obvious ; a ligature on a carrier (such as MacCormick's dissector) cannot be placed around a duct or vessel, unless that structure has first been dissected, and actually displayed. On the other hand, it is easy, so very easy, to apply a clamp to a spot where it is thought that the duct or vessel should or might be. Moreover it should be plain that the risk of a ligature slipping after ligation in continuity is far less than that which exists following the crude practice of ligation after crushing with forceps.

The clinical manifestations of gross damage to the bile-ducts are stark in their immediate post-operative revelations. But there are many patients in whom there has been a ' near miss ' with the gall-bladder forceps—a partial crushing of the common bile-duct, who return months or years later with a traumatic stricture. We have therefore no alternative but to discard the Moynihan forceps from the armoury upon which we draw for cholecystectomy, on the grounds that it is a very dangerous weapon.

b. **Biliary Extravasation.**—Attention has recently been drawn to this subject by my friend and colleague Graham McKenzie (1955) in a most able and instructive paper. He states that the literature on post-operative biliary extravasation is poor. And so it is. Moreover, bile peritonitis is usually described as producing diffuse abdominal pain, tenderness, rigidity, and a varying degree of shock. McKenzie's paper is an important one, and to my mind a distinct contribution to surgical literature, for not only does it dispel the vague and false clinical syndrome of bile peritonitis which has been accepted, but it provides an illuminating picture of the condition as it really occurs. It was shown, by the author referred to, that the patients who suffer from biliary extravasation following cholecystectomy or operations on the bile-ducts could be divided into two groups.

The first of these included those patients in whom there was an acute onset with shock and collapse as the outstanding feature—the shock being of marked degree. It developed within 48 hours of operation, but in only one patient in this group was there any severe abdominal pain. A study of the histories of these particular patients has been, to me, very instructive, for it has shown how easy and perhaps how convenient it would be to find an excuse when a patient suddenly collapses after an upper abdominal operation. Therefore one of the devices under which we now work is that, " In this surgical unit, coronary occlusion never follows an operation on the biliary tract ". This is a useful, if somewhat strident, injunction to our juniors with regard to this matter. Nowadays in our hospital we do not see at autopsy patients of ours who have died after operations on the biliary tract, with pints of bile in the peritoneal cavity. We are all concerned with the subject, and it is important that all who take it upon themselves to remove the gall-bladder or open the common bile-duct should be aware of the consequences which may follow.

The second group of patients were those who presented a subacute or insidious onset and course. In these, abdominal pain was a feature in about half of the patients only, but it is significant that in the other half the pain was either mild or there was none at all.

Another striking feature in some cases was the long latent period following operation, during which time these patients appeared to be convalescing quite normally. One patient did not complain of any pain until 30 days after operation and a further 30 days passed before the abdomen was re-opened and a collection of bile evacuated.

I commend the article from which I have quoted to all who operate on the gall-bladder : surgeons simply cannot afford to be ignorant of this subject and its beguiling clinical manifestations. Although I have been alert in this regard, a short time ago I wavered after having seen a patient who had collapsed two days after cholecystectomy. It just did not seem possible, her abdomen being as it was, that this patient was harbouring a large quantity of bile in her peritoneal cavity. So we waited—for a time. Then she was fortunate enough to complain of pain in the shoulder and thereafter all was well.

c. **The Post-cholecystectomy Syndrome.**—Under this heading could be included a rather nebulous variety of conditions, for even the definition of the term is clouded with inconsistencies ; but out of the mist emerges in the clear three syndromes which eventually stand upon firm clinical ground. However, at this juncture we must dismiss from consideration those patients who have had a eunuchoid gall-bladder removed, recognizing, as we do, that they provide the majority of the cases of the post-cholecystectomy syndrome, which from time to time is apt to be endemic in certain areas where the operative fervor of unqualified men cannot be denied unrestricted surgical play.

The less abstract of the post-cholecystectomy syndromes are those depending upon : (i) Recurrent stone formation ; (ii) The residual stone ; (iii) Ampullary stenosis.

i. *Recurrent Stone Formation.*—When stones are removed from the common bile-duct some time after cholecystectomy, it may be argued that they were overlooked on the former occasion. Certainly the older one gets, the more liberal and the less critical one becomes about others with regard to this possibility. But it is a fact that recurrent stone formation in the common duct is a problem to be faced not uncommonly. Any doubts I ever held in this regard were removed when I performed the fourth choledochotomy on an old lady after she had been previously operated on by three surgeons of repute within the space of ten years. In this patient the common bile-duct was the size of the ileum and

* Sir Alexander MacCormick, K.C.M.G., M.D., of Sydney—the first of five Australian surgeons to be elected as Honorary Fellows of the Royal College of Surgeons of England.

several very large soft stones, which could not possibly have been overlooked, were removed. It seemed to be fairly obvious that duct stasis was at the bottom of this trouble and therefore a short-circuit was fashioned—a defunctioned en-Y jejunal loop being used for the purpose on this first occasion and

FIG. 570.

FIG. 572.

subsequently on other patients presenting a similar problem. All of these patients have been relieved symptomatically. They may still be forming stones, but at least they have no biliary obstruction. I have the feeling that in patients with such a clinical history, when a somewhat similar biliary pathology has been revealed, the short-circuit operation may prove in the end to have a more lasting effect than sphincterotomy, simply by analogy—one internal urethotomy *per se*

FIG. 571.

never cured a urethral stricture. It is now pertinent to ask at what stage in the patient's career of recurrent stone formation does the surgeon become discontented with the operation of choledochotomy alone. I would suggest that even at the second operation (i.e., the one which follows the first surgical attack on the gall-bladder and the common duct), if the common bile-duct is dilated, if the stones are large and soft, and if an appreciable time has elapsed since the first operation, something more than a mere cleaning out of the ducts should be done. At such a time, and with such evidence, it is surely not premature to attempt to forestall the consequences of further stone formation.

ii. *The Residual Stone.*—At the present time this problem usually arises in the immediate post-operative period, so the patients who might be grouped under this heading should in no way be confused with those who have just been considered. An attempt was made to resolve this problem of the retained stone by those who were responsible for the introduction of operative cholangiography. I have had a trivial, and at the same time an unfortunate, experience with this procedure. I have obtained a statement from my colleague, E. S. R. Hughes, whose contributions to this and other surgical subjects have been extensive and at the same time so informative, and therefore I am grateful to him for permitting me to quote as follows : " Despite the fact that operative cholangiography was first introduced twenty years ago, it has never been widely accepted in Australia where the incidence of gall-stones is high. The

procedure is a relatively easy one, although cumbersome and time-consuming. The films have provided interesting anatomical information, but from the pathological point of view have proved of limited value. Gall-stones in the bile-ducts are not always seen in the film, whilst air bubbles give the films positive results. In over 100 cases in which I have used operative cholangiography I have not identified a stone in the hepatic ducts. The interpretation of pathological changes in the lower end of the common-bile-duct may be extremely difficult."

The problem is apt to become even more complex if we consider the patients whose post-cholecystectomy syndromes are, as it were, anticipated, i.e., those patients whose common ducts have been explored and upon whom a post-operative cholangiogram has been performed through the retained T-tube. The three cholangiograms reproduced are, in the light of subsequent events, easily interpreted. In *Fig.* 570 is shown the contrast between a stone and air bubble, and a second operation upheld this opinion. (This lady was referred from a country hospital to one of my colleagues.) In another patient, I could find nothing after exploring the common duct and an operative cholangiogram was performed. An X-ray film of the bony pelvis was produced! My impetuosity was unjustified on this occasion; no further film was taken and the abdomen was closed. The post-operative cholangiogram is reproduced in *Fig.* 571. The residual stone was removed a few weeks later. The common duct was opened in another patient and fifteen to twenty stones were removed. The post-operative cholangiogram is reproduced in *Fig.* 572. On the face of this radiograph and somewhat against my better judgement, a secondary operation was undertaken. No stone could be found even after the duodenum had been opened and sphincterotomy performed.

When symptoms recur some time after cholecystectomy, the physician or surgeon may have recourse to the intravenous cholangiogram. These pictures are not often completely satisfactory although occasionally there is a brilliant result. My radiological colleagues are well aware, as I am, of the difficulties which the surgeons impose upon them; the surgeons are naturally loath to accept questionable radiological evidence of the residual stone, and the matter is inclined to become just as controversial as this argument of mine has become discursive. Perhaps, at times, might it not be a good thing for 'the patient', if he could be allowed for a while, to wander beyond the ambit of prescribed routine investigation? If, at any time, he has attacks of severe pain or jaundice and he is unwell, no surgeon would deny him assistance, whatever the cholangiogram might have revealed.

As for me, no cholangiogram, however suggestive or however convincing it may appear to be, regardless of the stage at which it may have been produced, will, by itself, coerce me into a secondary operation on the biliary tract, unless the patient provides adequate clinical evidence that he has what is tantamount to biliary obstruction.

iii. *Ampullary Stenosis.*—On this subject I write from little experience. I have taken for granted that ampullary stenosis is a real thing because I presumed it was responsible for the recurrent stone formation in the patients to whom I have referred at an earlier stage. I am sure, however, that even the most experienced will find it difficult to evaluate precisely the part played by the sphincter of Oddi in the post-cholecystectomy syndrome, in recurrent pancreatitis, and perhaps in other disorders.

Be that as it may, occasionally on the clinical grounds of repeated attacks of pain—although mild in degree—temperature, and *jaundice* the common bile-duct may be explored some time after the operation of cholecystectomy. At this time the common bile-duct may not be inordinately dilated; aspiration may produce bile with some flecks. The duct is opened and no stones can be found. Repeatedly in my experience it has been found difficult to be sure if the sound which is passed down the duct actually passes through the sphincter of Oddi. Under such circumstances, especially in these cases of secondary intervention, the duodenum is opened, then the end of the sound may be the more easily and surely guided towards the ampulla. When it first begins to pass through the ampulla (and in order to facilitate this manœuvre the handle of the sound must be quite firmly depressed) it has the appearance of the glans penis revealed after attempting to retract the prepuce in a case of phimosis. Under these circumstances—which are, the indications for operation which have been suggested, and the subsequent operative findings which have been described—this appearance of the end of the sound intruding with difficulty into duodenum has led me to believe that ampullary stenosis is indeed a real thing. Within the past few years when this operative finding has presented, a 'dorsal slit' has been performed on the ampulla on each occasion.

The permanent results of this operation for a post-cholecystectomy syndrome of this particular type, or for recurrent pancreatitis, will be uncertain until a sufficient number of patients upon whom this operation has been performed can be followed up over a period of years. It will be up to some of my juniors to provide evidence on this subject. Personally I regard this sphincterotomy as a rather shoddy operation, and I am not sanguine regarding the results which may follow its performance.

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OBSERVATIONS ON THE MICROSCOPIC ANATOMY OF THE HUMAN ANAL CANAL

By E. W. WALLS

MIDDLESEX HOSPITAL MEDICAL SCHOOL, LONDON, W.1

It may seem strange that anything should remain to be said about the appearances presented by sections through the anal canal as seen by the light microscope, and yet a survey of the literature, this JOURNAL prominent in its midst, leaves no room for doubt. Statement and counter-statement are there in abundance, and this, together with the welter of anatomical terms employed, has created a situation which appears to stand in some need of clarification. Eponyms may have played their part in producing this state of affairs, and poor John Hilton's line has taken a few hard knocks of late, but, whatever the cause, the prime purpose of this paper is to attempt to harmonize the various accounts of the epithelial lining of the anal canal which have appeared over the past century or so. This is not an unworthy pursuit for an anatomist, particularly as the succession of terminologies which has been adopted by his fellows may have played a part in creating difficulty. That yet another anatomical terminology is pending will not come as a surprise, for anatomists have no secrets, but to some it may not be welcome news for all that.

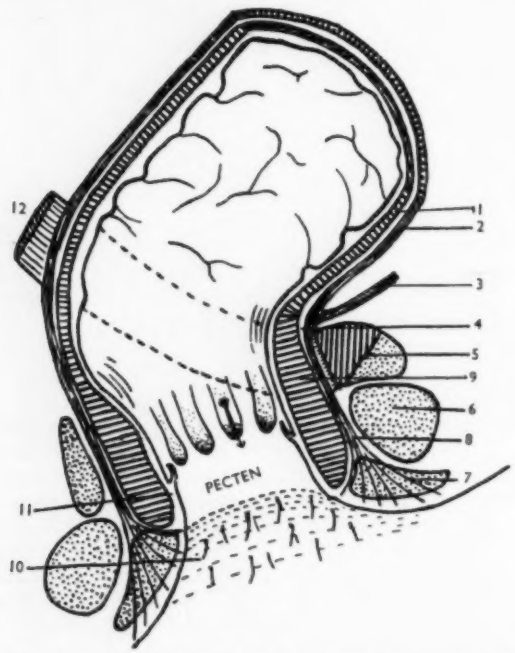

FIG. 573.—Diagrammatic section through rectum and anal canal (*after Grant*). 1, Circular muscle of gut; 2, Longitudinal muscle of gut; 3, Levator ani; 4, Anorectal ring; 5, Deep part of external sphincter and puborectalis fused with it; 6, Superficial part of external sphincter; 7, Subcutaneous part of external sphincter; 8, Conjoint longitudinal muscle; 9, Internal sphincter; 10, True skin; 11, Anal valves (of Ball or Morgagni); 12, Puborectalis part of levator ani.

The arrow lies between two anal columns (rectal columns of Morgagni) in a sinus of Morgagni, with its head reaching down into an anal sinus (crypt, pocket, or saccule) and in consequence really hidden by the epithelial valve-flap.

For the task in hand it is necessary as a first step to define as precisely as possible the territory under review; in what follows, the anal canal is taken as that part of the alimentary tract which commences at the level of the levatores ani muscles, and which, surrounded by the anal sphincteric musculature, passes downwards and backwards for about an inch and a half to open at the anus—a somewhat arbitrary point on the anal margin—an inch or two in front of the tip of the coccyx.

Thus defined, the anal canal commences at the anorectal ring, a composite muscular 'band', identifiable by palpation, formed by the upper part of the internal sphincter, the longitudinal muscle of the gut, the deep part of the external sphincter, and the puborectalis portion of the levator ani. Accordingly the folds in the mucous membrane which may form a naked-eye feature of this part of the tract may properly be referred to as anal columns (rectal columns of Morgagni), and their distal fused ends as the anal valves enclosing the pocket-like anal sinuses.

Some authorities, for example Gorsch (1955), consider the canal as commencing at the level of the anal valves, a level also referred to as the pectinate line, dentate line, sinuous line, crypt line, valvular line, papillary line, anocutaneous line (Herrmann, 1880), and even anorectal line; others, for example Morgan and Thompson (1956), consider the anatomical anal canal to extend from the anal valves downwards, but that surgically it is best to regard the canal as commencing at the anorectal ring.

In *Fig.* 573, which represents the anal canal and lower rectum cut in the sagittal plane, a few points call for comment.

Between the anorectal ring and the anal valves the lining is marked by the columns of Morgagni, longitudinal mucosal folds which may extend into the ampulla of the rectum but which are variable in size, number (6–12), and position. The anal valves and sinuses are also variable, but as a rule they can be well seen in the young child (*Fig.* 574).

Below the line of the valves the lining shows two zones, the pecten and the area of true skin.

The Pecten.—This zone, first so named by Stroud (1896) from its resemblance to a comb, extends for a distance variously described as 3–9 mm. (Stroud), 12–20 mm. (Robin and Cadiat, 1874), 10–15 mm. (Parks, 1956), from the line of junction of the internal and external sphincters, i.e., Hilton's white line, of which more will be said below. Above, it ends in a series of dentations of unequal development between adjacent members of which epithelial folds may enclose little pockets, the anal sinuses. Developmentally the dentations are the persisting highest parts of a series of longitudinal folds which extend from the anus upwards to the level of the valves, but which otherwise are scarcely recognizable in the fully formed canal. To name them, as some

authorities do, the ' anal columns ' is confusing, as this term is now reserved for the columns of Morgagni with which the dentations become continuous. In some cases the dentations override the columns of

FIG. 574.—Naked-eye appearance of the anal lining in a child of 8 years.

Morgagni and project as little papillæ into the lumen of the canal.

Before considering the histological structure of the anal canal, reference must be made to its development as described by Johnson (1914). *Fig.* 575 shows very simply his view of what happens.

In the embryo two swellings, the bulbus analis and the bulbus terminalis, form in the gut tube and with subsequent development become what Johnson calls the zona columnaris (i.e., the region of the columns of Morgagni) and the zona intermedia (i.e., the pecten). Early on, the bulbus terminalis is limited below by the anal membrane, which is the meeting place of the entodermal hind-gut tube above

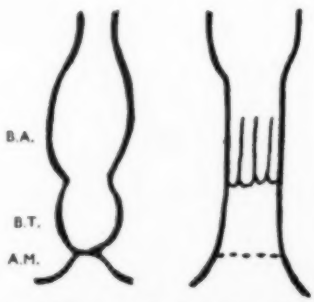

FIG. 575.—Scheme of development of the anal canal (Johnson). B.A., Bulbus analis; B.T., Bulbus terminalis; A.M., Anal membrane. According to this view the former site of the anal membrane is some distance below the anal valves.

and the ectoderm-lined anal pit or proctodæum below. Although he did not claim absolute correspondence between the boundaries of the two swellings with those of the zones which they come to form, Johnson felt sufficiently certain about a general correspondence to state: "It follows that at birth and in the adult, the limit between the two germ layers must lie somewhere near the lower boundary of this zone." That is to say, Johnson thought that the former site of the anal membrane would be somewhere towards the lower limit of the pecten. With regard to the relative contributions made by ectoderm and entoderm to the canal lining it should be said that the account given by Tench (1936) differs somewhat from that of Johnson. However, if Johnson's account is correct it follows, first, that the statement commonly made, that the anal valves represent the remains of the anal membrane, is incorrect, and, second, that to apply the term ' cutaneous ' to the region of the pecten is unwise even though it be allowed that its microscopic structure lends weight to this use of words.

In discussing the lining of the anal canal it is of some importance to understand quite clearly what is meant by ' mucous membrane '. For some authors the term seems to mean only a tissue containing actual mucus-producing cells—a point of

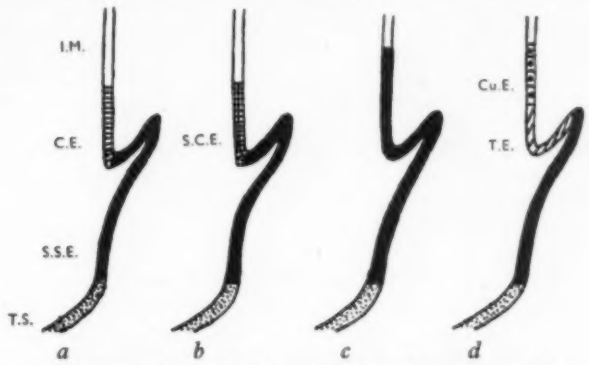

FIG. 576.—Diagram of the anal lining epithelium according to various authors. *a*, Robin and Cadiat; *b*, Johnson, Parks; *c*, Goligher and others; *d*, Morgan and Thompson.
I.M., Intestinal mucosa; C.E., Columnar epithelium without intestinal glands; S.S.E., Stratified squamous epithelium; T.S., True skin; S.C.E., Stratified columnar epithelium; Cu.E., Cubical epithelium; T.E., Transitional epithelium.

view which seems reasonable enough—and accordingly the pecten, lined as it is by stratified squamous epithelium and devoid of glands, would be excluded. In his careful and very readable discussion on Hilton's line Ewing (1954) would only allow one point in Hilton's original description—namely, that the line of junction between the internal and external sphincters is an important surgical landmark; all else he denied, including Hilton's claim that this level corresponded exactly with the junction of mucous membrane and skin, and this for the reason that Hilton's line was not the meeting place of skin and columnar epithelium. Now it may be that Hilton was in fact correct, albeit the intersphincteric interval is the level at which true skin merely changes over to stratified squamous epithelium devoid of hair and sweat glands. There is nothing novel in a mucous membrane being covered by stratified squamous epithelium—the mouth and œsophagus come readily to mind—nor do all mucous membranes produce mucus, for the stratified squamous lining of the vagina is moistened solely from above. To argue that the term is open to criticism is understandable but unhelpful. If appeal is made to development little help is forthcoming, for entoderm is not the only embryonic tissue which gives rise to mucous membrane. For example, the mucous membrane lining the anterior parts of the nasal cavity and of the mouth, and the lower part—how much, it

would seem, is uncertain—of the anal canal is ectodermal in origin, while that lining the urogenital tract is in considerable part differentiated from mesoderm. It is obvious that the embryonic origin of epithelium cannot be inferred by reference to its structure when fully formed.

It follows from what has been said that the term ' mucocutaneous junction ', which at present is widely used as being synonymous with the pectinate line, is one which is capable of wrong interpretation, an important point and one stressed by Goligher, Leacock, and Brossy (1955). On the one hand it can be held to be at the intersphincteric line, the level at which Johnson believed anal canal entoderm and ectoderm were for a time separated by the anal membrane, and on the other it can be taken as the line of the valves which according to most current accounts (but on what evidence is not clear) represents the former site of the anal membrane. However, even if the second view is allowed, is the valve line in fact the level at which stratified squamous epithelium and typical intestinal mucosa meet? The short answer to this is 'no', but for a full appreciation of the situation reference must be made to the expressed opinions of others, before the findings of the present investigation are presented.

As described by Johnson (1914) the histological structure of the anal canal shows three transitions between the simple columnar epithelium of the rectum and the region of the perianal true skin. The first is a rather gradual change from rectal type epithelium to stratified columnar epithelium which forms the lining of the canal in the region of the columns of Morgagni. On the basis of the histological appearances Johnson gives the name ' anorectal line ' to this level, but as described by him it is in fact somewhat below the upper limit of the canal as defined earlier in this paper. At the level of the valves the second change takes place rather abruptly, stratified columnar epithelium giving way along a zigzag line to the stratified squamous epithelium of the pecten. The pecten lining is composed of several layers of polygonal cells which form a thicker layer than the epidermis of the skin. Dermal papillæ are present, but hairs and sweat-glands are absent. A few isolated sebaceous glands without hairs may be found in the lower part of this zone, the epithelium of which may show slight cornification. At this lower limit the pecten zone gradually goes over into skin, the actual line being taken as that where hair follicles appear. Only in this perianal area are the circumanal sweat-glands of Gay (1871) found.

According to Ewing (1954) the line of junction of stratified squamous and columnar epithelium is usually about 1 cm. above the lower margin of the internal sphincter, and may even be above the line of the valves. This author, however, makes the point which Harris (1929) emphasized, that there is a good deal of interpenetration of the epithelia and that in consequence precise demarcation of the line of junction is difficult. Ewing did not go into this point any further, but Goligher and others (1955) gave the matter careful scrutiny. While agreeing with previous workers that the lining below the valves is formed by modified skin, they found that at the valves themselves the epithelium underwent no striking change other than becoming thinner and, moreover, that above the valves it continued as stratified epithelium of several layers of rather flattened cells, the more basal cells being cuboidal. The level at which this gives way to typical intestinal mucosa is stated by them to be almost at the anorectal ring.

It is in fact the nature of the lining between the valves below and frank intestinal mucosa above which appears to be in dispute, but the various authors' views just reviewed do not end the matter. Thus Morgan and Thompson (1956) described the epithelium of this part of the canal as cuboidal above and transitional below, whereas Parks (1956) gives a description which is very similar to that of Johnson (1914). According to Parks the stratified squamous epithelium of the canal gives way at the level of the anal crypts to stratified columnar epithelium which continues upwards for 0·25–1 cm. To these accounts must be added that of Robin and Cadiat (1874), who described a zone of prismatic, i.e., columnar epithelium, devoid of intestinal glands which extends from the bottom of the crypts upwards to its meeting with intestinal mucosa 5–8 mm. above.

Fig. 576 is a graphic summary of the views of the authors quoted.

PRESENT INVESTIGATION

It is perfectly clear, if the various accounts of the canal lining outlined above are accurate for the sections reported upon, that there is a considerable range of variation in the histology of this region ; and in anticipation of what is to follow it may be said that this is indeed the situation. For in the present study based on the examination of 20 canals from adults and children, sections could be found to illustrate many of the differing features claimed by earlier workers. Longitudinal sections were made in the coronal and sagittal planes on the sledge or rotary microtome according to the size of the paraffin block, and the following staining methods used : hæmatoxylin and eosin ; hæmatoxylin and Van Gieson ; Schiff reaction (P.A.S.) ; Southgate's method for mucin ; Verhoeff's method for elastic fibres ; Heidenhain's azan method ; Gomori's hexamine silver method for melanin.

The observations to be presented are concerned primarily with the epithelium of the canal and of the various glands which are present at different levels. Little will be said of the arrangement of the sphincters or of the subcutaneous tissue which bears such an important relation to the course followed by pathological processes affecting this region, as the recent papers by Morgan and Thompson (1956), Parks (1956), and Goligher and others (1955) have clarified the situation for surgeons and pathologists alike.

Before presenting my findings it is necessary to point out that in many longitudinal sections of the canal there is little evidence of an anal valve. Even in children, unless hundreds of serial sections are examined, it is quite easy for the plane of section to pass between adjacent valves ; in adults not only are the valves less well developed as a rule, but practical considerations make such a study virtually impossible. Many sections illustrated in the literature do not pass through a valve at all, and pathologists who in general can only examine a

FIG. 577.—Cyst of rectal-type mucosa in the upper part of the anal canal. Adult.

FIG. 578.—Section of anal valve to show stratified squamous epithelium covering both faces of the valve and giving way to stratified columnar in the crypt. Adult.

FIG. 579.—Section of anal canal to show stratified squamous epithelium extending upwards until intestinal mucosa is reached. Child aged 9 months.

FIG. 580.—The meeting place of stratified squamous epithelium and intestinal mucosa. This is a higher power view of part of *Fig.* 579.

relatively small number of sections from any one block should not of necessity expect to find a 'text-book-figure' section through valve or crypt.

Findings.—In most specimens the line of the valves was found to lie somewhat below the middle of the internal sphincter, in agreement with the level given by Goligher and others (1955), viz., between its middle and the junction of its middle and lower thirds. In extent the adult sphincter is about 30 mm., so that in round figures the lining may be considered to comprise a zone of 17 mm. above the valves and one of 13 mm. below, with, of course, a range. In all cases the highest part of the upper zone was lined for 4–16 mm. by rectal-type mucosa ;

that is to say, the epithelium is simple columnar and the mucous membrane shows small tubular prolongations, the intestinal glands. Solitary lymph nodules are found beneath the epithelium. Its character is

FIG. 581.—Longitudinal section of anal canal to show interdigitation of epithelium. Adult.

shown in *Fig.* 577, which also shows a small epithelial cyst.

This finding is of interest, as it recalls the observation made by Johnson (1914) that such cysts exist for a long period of embryonic life but disappear before birth. Their possible role in the incidence of proctitis has been suggested by Harris (1929). Robin and Cadiat (1874) stated that the last few intestinal glands undergo a change of direction compared to those above, and also they may be more closely packed with their cells more darkly staining; while agreeing that these appearances may be noticed, they are not constant.

Still keeping to the zone of the canal above the valves, the next part of the lining to be considered is that between the level at which intestinal mucosa ends and the line of the valves. In extent this region is very variable, 1–9 mm., figures well in agreement with the 0·25–1 cm. stated by Parks (1956) for the extent of the stratified columnar epithelium which he found between the bottom of the crypts and the commencement of intestinal mucosa. Measurement apart, however, my agreement with Parks is not complete, for while I agree absolutely that stratified columnar epithelium does form the lining here in some cases, in others it is either absent or if present forms only a part of the epithelium between valves and intestinal mucosa. In *Fig.* 578 the appearances shown agree with his findings, and it is included both for that reason and also because it illustrates the arrangement of tissues which he described as the mucosal suspensory ligament (Parks, 1954, 1956). I must confess, however, that from the latter point of view it is a carefully selected section, and many of my preparations would not serve the purpose. Nevertheless, through Mr. Parks's kindness I have had the opportunity of examining his material, prepared

FIG. 582.—Longitudinal section through anal valve to show the change from stratified squamous epithelium to stratified columnar epithelium taking place on its supero-external surface. A smaller valve tag, clad by stratified columnar on both faces, is also shown, together with crypt glands about to open into the canal. Adult.

following submucosal injection of saline, and I am bound to agree that the submucosal and marginal spaces to which he draws attention are there readily recognizable.

In some cases the appearances described by Goligher and others (1955) were found; i.e., the zone between valves and intestinal mucosa is lined by stratified squamous epithelium. *Fig.* 579 illustrates this and as it is taken from a child aged 9 months it has added interest in so far as it would invalidate the argument that the occurrence of such an epithelium in this zone in an adult is always an example of metaplasia. In this specimen the epithelium in the depths of the crypt is of stratified columnar type, but once clear of the shelter afforded by the valve becomes once more stratified squamous, and continues as such until intestinal mucosa is reached (*Fig.* 580). At the place of meeting it is common to find overlap of the two types of epithelia (*Fig.* 581).

The epithelium on the upper, i.e., supero-external surface of the valve, is variable, sometimes stratified squamous (*Fig.* 577), sometimes stratified columnar, or indeed the change may take place anywhere along that face (*Fig.* 582).

However, variation between individuals, both in adults and children, is not the only factor which complicates this supravalvular zone, for as seen in longitudinal section it may show considerable variation along its length. Thus while some sections show only stratified squamous, or stratified squamous with a small portion of stratified columnar in the crypts, and others only stratified columnar, it is not uncommon to find several different types of epithelium succeeding one another. Thus stratified squamous of twelve layers or more may merge into

stratified columnar, or into a low stratified polygonal of only three or four layers; patches of simple columnar have been found, and in places the appearance of transitional epithelium may even be suggested.

The next part of the lining to be considered is the pecten, and here little need be added to Johnson's account. Between the line of the valves and the intersphincteric interval, a distance which varied in my adult material from 8 mm. to 15 mm., the lining is formed by stratified squamous epithelium which may form a thicker layer than that of the epidermis of the skin, and keratinization of this layer may be present as high as the valves. Dermal papillæ, which are

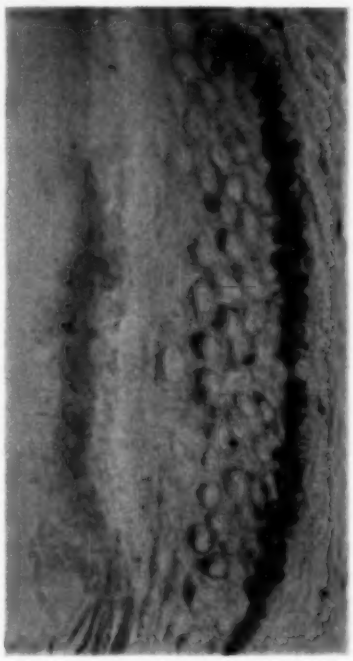

FIG. 583.—Section of perianal skin stained for melanin.

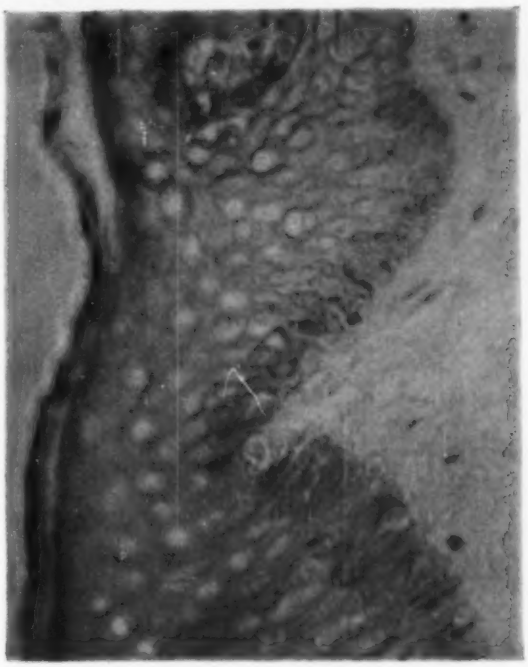

FIG. 584.—Section of the pecten just below the anal valves stained for melanin.

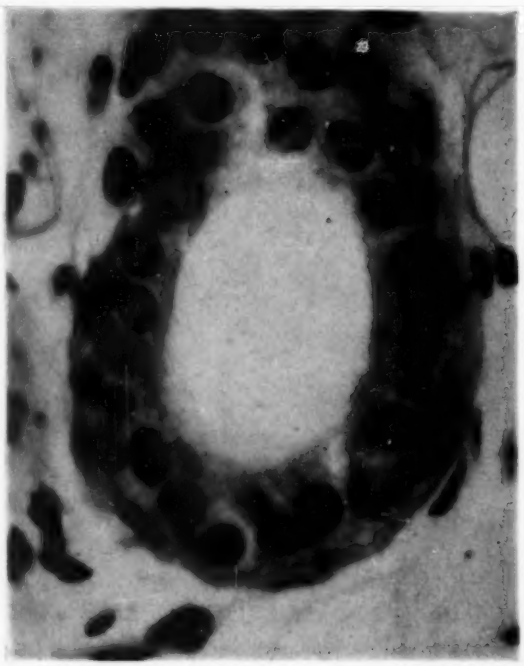

FIG. 585.—High-power view of a section through a perianal sweat-gland. One or two myoepithelial cells are seen lying between the secretory epithelium and the basement membrane. Child aged 9 months.

FIG. 586.—High-power view of a sweat gland cut twice, once in cross section and once tangentially. In the latter the myoepithelial cells are cut along their length. Child aged 7 years.

well marked in the perianal skin, are in this zone of variable development. Melanin pigment is not absent from this zone throughout its extent, but gradually diminishes in amount from below up and is no longer present a short distance below the valves (*Figs.* 583, 584). There is no basis for the belief that pigment ceases abruptly at the intersphincteric interval (Hilton's line). Apart from a very occasional rudimentary hair follicle or sebaceous gland these elements are absent, as are sweat-glands, although Parks (1956) did notice the last occasionally.

As the pecten zone merges into the true skin of the perianal region, hairs, sebaceous glands, and sweat-glands appear. The latter glands are shown in *Figs.* 585, 586, in which the feature of interest is the myoepithelial cells. In *Fig.* 585 these elements are seen lying between the basement membrane and the cubical secreting cells, while in *Fig.* 586 a fortunate tangential section through one portion of the gland tube has revealed the myoepithelial cells in considerable number on the outer surface of the underlying gland cells. Seen thus, cut along their length, it is easy to appreciate the occasional occurrence of myoepitheliomata.

Besides sweat-glands there is present in the circumanal skin a ring of apocrine glands, first described by Gay (1871). Of great size, these structures present a striking appearance in section (*Fig.* 587), and the possibility of their giving rise to perianal hydradinoma as mentioned by Gorsch (1955) can be readily understood.

The Anal Intramuscular Glands.—Known variously as intramuscular, anal, perianal, and crypt glands, these structures were described nearly eighty years ago by Herrmann (1880) and by Herrmann and Desfosses (1880), but nearly fifty years were to pass before their importance in relation to pathological processes was recognized (Lockhart-Mummery, 1929; Gordon Watson and Dodd, 1935; Tucker and Hellwig, 1933, 1934, 1935; Hill, Shryock, and Rebell, 1943; Kratzer and Dockerty, 1947). The findings of these workers, together with the careful account of their development given by Johnson (1914), have led to a good understanding of the general anatomy of these glands, although speculation as to their function is still rife. That they play a role in

FIG. 587.—The apocrine glands of the perianal skin. Adult.

FIG. 588.—Opening of anal gland. Compare with *Fig.* 589. Child aged 9 months.

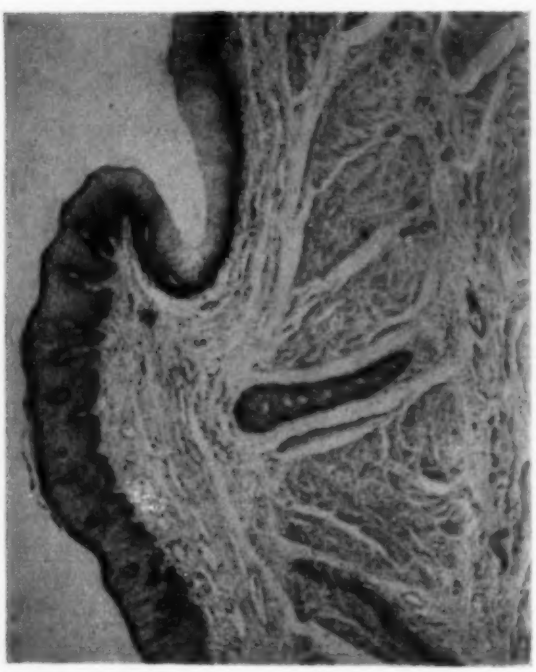

FIG. 589.—The lower part of the gland shown in *Fig.* 588. In this part of its course it is seen passing into the substance of the internal sphincter.

the occurrence and spread of anorectal suppuration seems to be established, and that they can be the seat of malignant change has been shown by Scarborough (1941).

FIG. 590.—Section to show tubules of a crypt gland lying alongside a typical mucous gland. Adult.

There seems little doubt that they are constant structures, but unless serial sections are examined they may well be missed. For the most part they open into the anal crypts (*Fig.* 588), although I have found an occasional gland opening at a slightly higher level. Their depth of penetration varies, but some unquestionably leave the submucosa and penetrate the internal sphincter (*Fig.* 589). In structure the glands are essentially tubular, some fairly simple tubes and others more highly branched. Histologically they have been variously described, but the range of appearances met with in the canal epithelium being what it is this would not seem surprising. Typically the gland ducts are lined by stratified columnar epithelium, which as the branches are reached gives way to a stratified epithelium, the cells of which next the lumen are more cubical. Glandular acini are virtually absent, but in one specimen an undoubted gland with typical acini lay in the submucosa alongside the terminal tubules of a crypt gland (*Fig.* 590). Unfortunately it was not possible to obtain a sufficiently good series of sections of this block whereby true continuity of the two might have been established. Hill and others (1943) described lack of complete canalization in the terminal parts of the crypt glands in three newborns, a feature which is shown in *Fig.* 591.

With regard to secretory activity of the anal glands there is considerable doubt. Small cysts arising from these glands are not uncommon and this suggests at least past activity, but no worker has yet reported positive results for mucin in more than a fraction of his material. This, too, was my experience, and such success as was obtained was limited to a faint reaction in the gland cells next the lumen, and that only in their innermost parts.

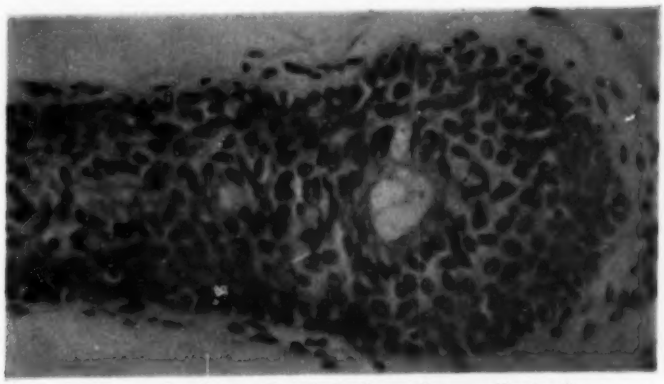

FIG. 591.—Section to show lack of complete canalization in a crypt gland. Child aged 9 months.

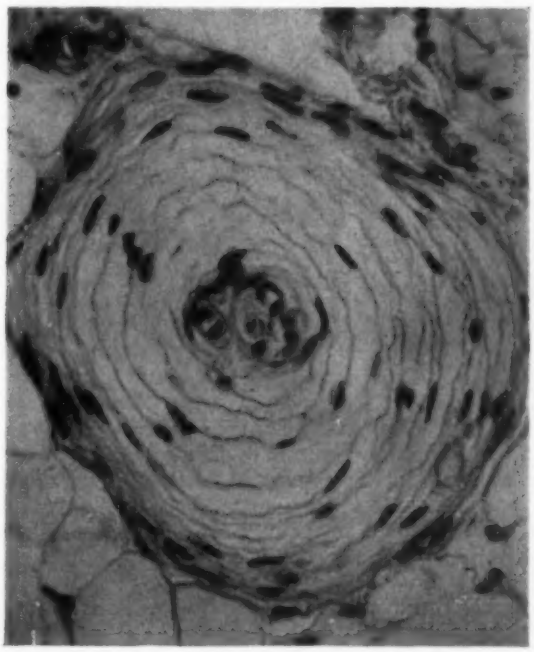

FIG. 592.—Section of a Pacinian corpuscle in the perianal skin.

Although it is proposed to make the innervation of the anal canal epithelium the subject of a special study, it would I think be worth while to point out that it is not uncommon to find Pacinian corpuscles in this region (*Fig.* 592). Sites of their occurrence in the present material are the perianal subcutaneous tissue, the deep surface of the lower border of the internal sphincter, and between the subcutaneous and superficial portions of the external sphincter. So great is the sensitivity of response of the external sphincter, both as seen clinically and as tested by electromyography (Floyd and Walls, 1953), that the finding of such nerve-endings is not surprising. However, as yet no evidence of muscle spindles has been found in the external sphincter.

CONCLUSIONS

The range of appearances presented by the epithelial lining of the anal canal above the level of the anal valve line is great. The forms of epithelium variously described by previous workers as typical of this zone have been identified in the present investigation, and the point made that any one type is not in fact consistently to be found.

The wide range of epithelial types is a matter of some importance to pathologists called upon to report on material from this region, and it is hoped that in pointing out the normal histological variations this paper may prove of service.

I am grateful to Dr. B. C. Morson, Pathologist to St. Mark's Hospital, Professor R. W. Scarff of the Bland-Sutton Institute of Pathology, and Dr. M. Bodian, Director of the Department of Morbid Anatomy, Hospital for Sick Children, Great Ormond Street, for their kindness in supplying material; to Mr. P. R. Runnicles for his technical assistance in preparing the sections and also the photomicrographs which illustrate them; and to my secretary, Miss P. G. Evans, for typing the manuscript. To them all I extend my warmest thanks.

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SWELLINGS OF THE JAW

BY R. W. SCARFF AND A. D. THOMSON

FROM THE BLAND-SUTTON INSTITUTE OF PATHOLOGY, THE MIDDLESEX HOSPITAL, LONDON, W.1

THE mandible and maxilla can muster a more confusing variety of tumours than any other bones in the body. Not only may the usual skeletal tumours occur but neoplasia may also arise in the soft tissues within the bones and in the intricate epithelial and connective-tissue derivatives of developing teeth. There results, therefore, an array of tumours of unusual complexity and variation which is further confused by the frequency of dysplastic and reactive processes in this region to obscure the picture still further.

Any classification is therefore extremely hazardous, but it is in just such a branch of pathology that a logical subdivision of the lesions becomes of paramount importance in order to establish some semblance of clarity in an otherwise confusing subject.

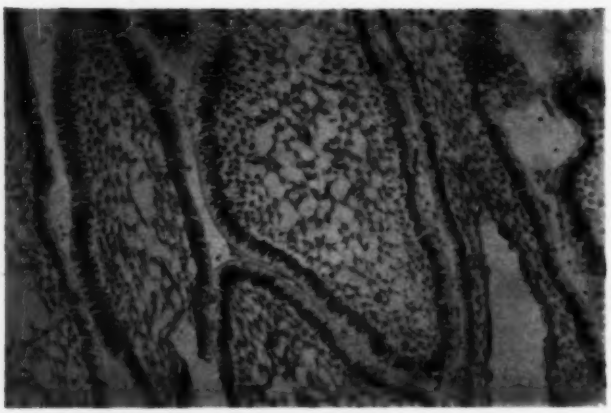

FIG. 593.—Adamantinoma. Showing the core of stellate cells surrounded by columnar epithelium. (× 50.)

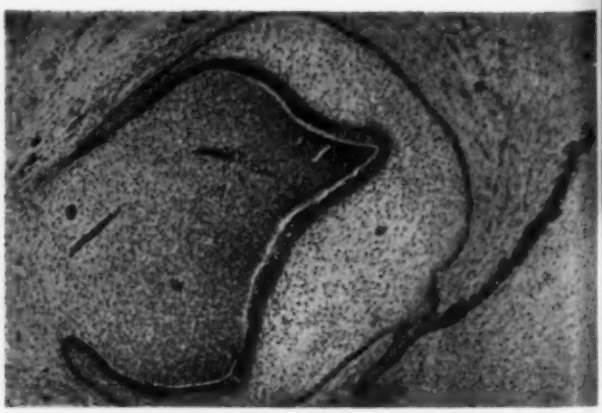

FIG. 594.—Enamel organ. Showing the detailed appearance of the enamel organ and its similarity to the adamantinoma. (× 18.)

In practice it is found that tumours of the jaw bones may be subdivided as arising from :— (*A*) The tissues of developing teeth ; (*B*) The skeletal tissues ; (*C*) The soft tissues within bone.

A. Tooth Tissues	*B. Skeletal Tissues*	*C. Soft Tissues within Bone*
ODONTOMES	1. *Bony Tumours*	1. *Fibrous Tissue*
1. Dental cyst	*a.* Osteoma	*a.* Fibroma
2. Dentigerous cyst	*b.* Osteosarcoma	*b.* Ossifying fibroma
3. Fibrous odontome : Cementoma Dentinoma	2. *Cartilaginous Tumours*	*c.* Fibrosarcoma
4. Composite odontome	*a.* Chondroma	2. *Blood-vessels* Hæmangioma
5. Adamantinoma	*b.* Chondrosarcoma	3. *Nerve Tissue*
	3. *Giant-cell Tumour*	*a.* Neurofibroma
		b. Neurinoma
		c. Neurofibro-sarcoma
		4. *Marrow Cells*
		a. Myeloma
		b. Ewing's tumour
		c. Reticulum-cell sarcoma

This method of classification encourages clarity and simplicity in an area where tumours abound and, although not complete, it does encompass the majority of the neoplasms that have been encountered. During the last few years we have met with many such swellings with unusual features which would appear to merit description. An additional problem in any discussion on swellings of the jaw is the frequency of reactive and dysplastic lesions that may cause enlargement or destruction of the jaw bones, and this problem is exemplified in osteofibrosis of the maxilla.

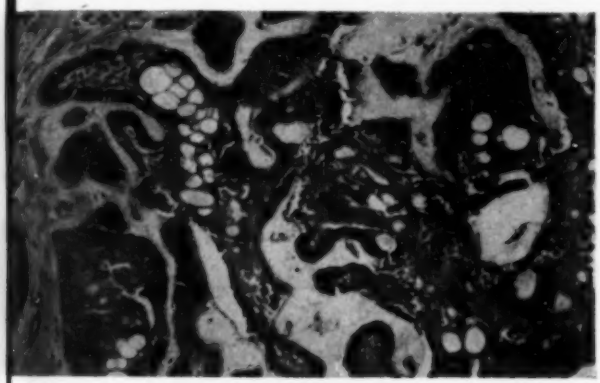

FIG. 595.—Adamantinoma. Showing the squamous- and basal-cell appearance of one type of adamantinoma. (× 50.)

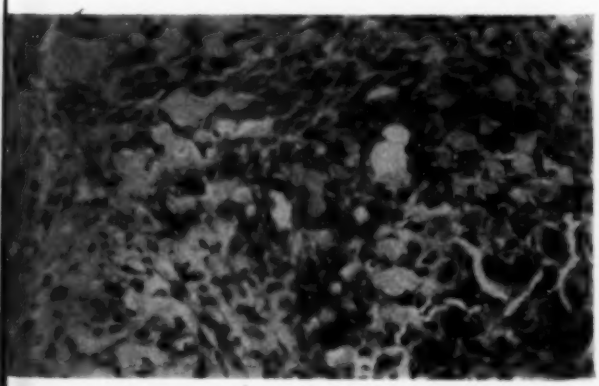

FIG. 597.—Osteosarcoma. Showing a pleomorphic-cell tumour with spicules of osteoid tissue. (× 180.)

Osteofibrosis of the Maxilla.—This is a curious condition which appears to begin in childhood, in which there is enlargement of the maxilla commencing in the upper alveolus in the neighbourhood of the first molar and second premolar tooth, and which usually undergoes natural arrest after varying periods of growth and varying degrees of deformity (Scarff and Walker, 1948). Numerous suggestions have been put forward as to the nature of this condition. Knaggs (1926) favours a diagnosis of osteitis fibrosa, while Furedi (1935), Thoma (1944), and others consider it as a neoplastic process, and probably in the light of this the non-committal term 'osteofibrosis' would seem preferable.

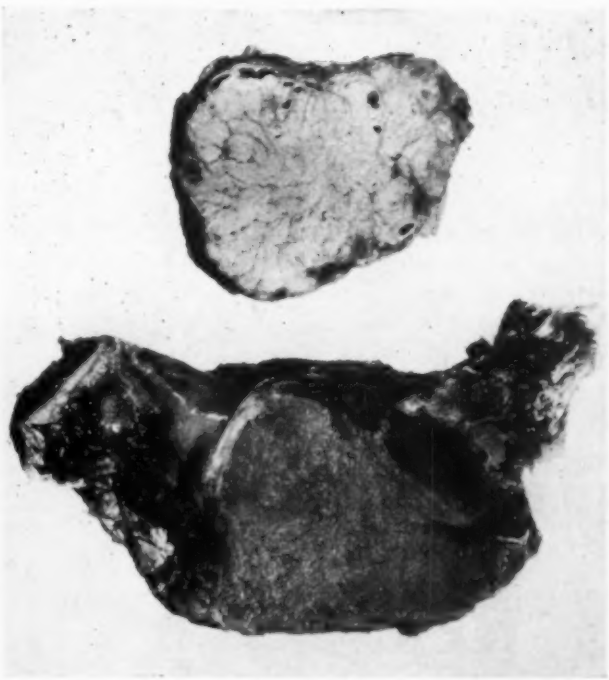

FIG. 596.—Adamantinoma. Showing an adamantinoma (below) removed in 1930 with the recurrence (above) removed in 1951.

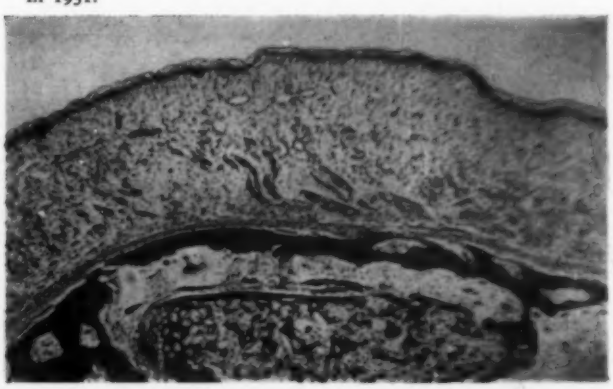

FIG. 598.—Showing a fœtal jaw with a central core of bone and calcified cartilage with small dental buds from the oral squamous epithelium. (× 18.)

Dental Cysts with Rodent Ulcers.—The usual situation of a dental cyst is at the root of a tooth and the cyst wall is lined by squamous epithelium. An unusual combination is the presence

of multiple squamous-lined cysts in the jaw associated with rodent ulcers on the skin surface of the body. We have records of a family in which at least three members have cysts lined by benign squamous epithelium in the jaw bones and these three have developed rodent ulcers before the age of 35. At the time of death in one of them the face was virtually replaced by multiple basal-cell carcinomata.

Adamantinoma with Late Recurrence.—The adamantinoma is a tumour which shows a pronounced predilection for the lower jaw and arises in young adults. The tumour is composed of

FIG. 599.—Chondroma. Showing a low-power view of a chondroma. (× 3.)

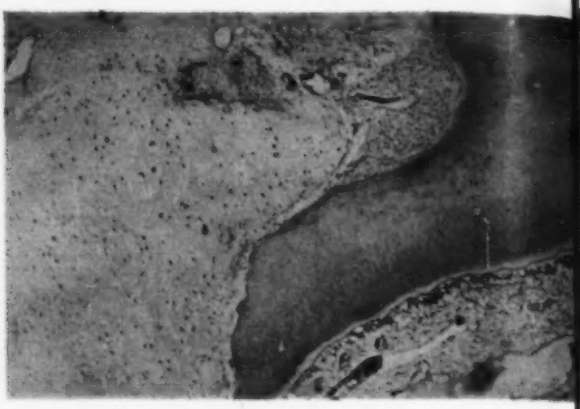

FIG. 600.—Chondroma. Showing involvement of the root of the tooth. (× 18.)

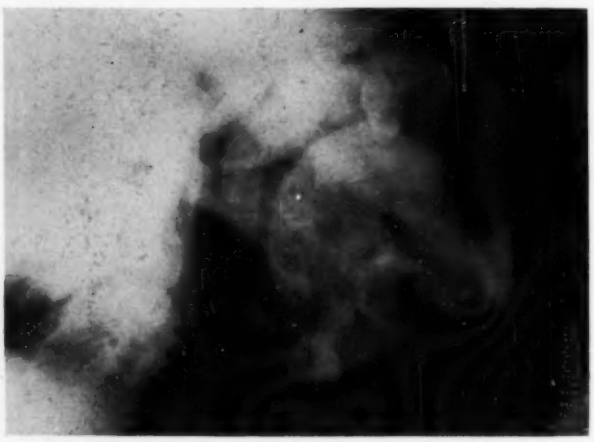

FIG. 601.—Chondrosarcoma. Radiograph of a chondrosarcoma of the mandible associated with Paget's disease.

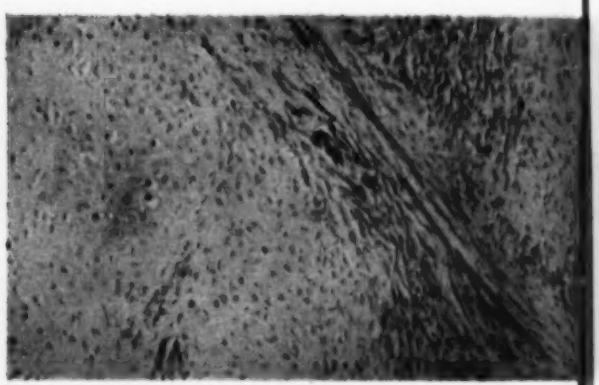

FIG. 602.—Chondrosarcoma. Showing the histology of the malignant cartilaginous tumour. (× 40.)

FIG. 603.—Reparative granuloma. Showing the X-ray appearance.

rounded or elongated islands of epithelial cells in a connective-tissue stroma)*Fig.* 593) and the appearances bear a striking resemblance to the enamel organ (*Fig.* 594). The epithelium of the adamantinoma may show considerable modification in its appearance in that the tumour may consist of sheets of squamous cells with areas of cornification at the centre of the epithelial islands while the periphery may show areas reminiscent of a basal-cell type of tumour (*Fig.* 595). The solid cellular components of the tumour give way in other areas to extensive cyst formation, and these cystic areas are due to degenerative changes in both the stellate cells and in the connective-tissue stroma.

In spite of the pictorial similarity of the adamantinoma to the enamel organ, the exact histogenesis of this tumour remains in doubt. It is remarkable that enamel is never identifiable in an adamantinoma, and it is probable that most examples arise from the epithelial rests of Malassez.

The adamantinoma is usually a benign and slowly growing tumour, but it is very prone to recur after operative resection. *Fig.* 596 shows an

adamantinoma removed in 1930 by Sir Gordon Gordon-Taylor. The patient remained perfectly well until 1951, when a small tumour recurrence was found at the operation site. This was resected and the patient has remained free from further tumour.

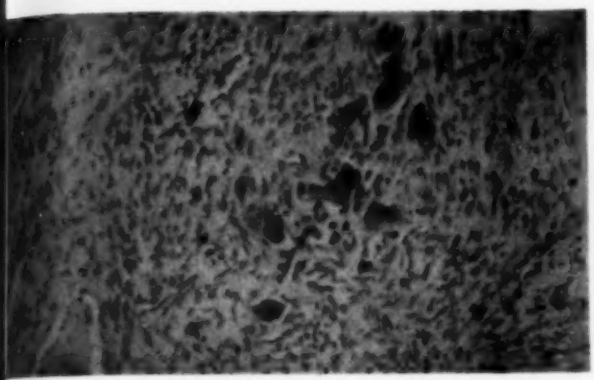

FIG. 604.—Reparative granuloma. Showing the fibrous tissue with scanty giant cells and some areas of new-bone formation (× 78.)

Osteosarcoma with an Unusual History.—Osteosarcoma of the jaw is a rare condition and the literature of the subject stresses that the tumour develops in the young age groups. This has not been our experience and its occurrence in middle age or in association with Paget's disease has been the rule.

FIG. 606.—Ossifying fibroma. Showing the jaw swelling.

In 1940 a man who was then aged 20 developed actinomycosis of the right mandible. This infection was treated by irradiation with excellent results and the patient remained entirely well until 1949, when a tumour developed in the mandible at the same site as the irradiation. Biopsy of the tumour showed an osteosarcoma (*Fig.* 597) and this was treated by X-ray therapy followed immediately by a local excision. Within six months the tumour had recurred, and in spite of further irradiation to a tumour dosage of 8000 r the patient died with invasion of the base of the skull and pulmonary metastases. It is interesting to speculate whether the first course of irradiation for actinomycosis in 1940 played any part in the induction of this osteosarcoma and whether this case is of similar pathogenesis to the tumours reported in the jaw following the absorption of radioactive material in luminous watch-dial painters (Martland, 1931).

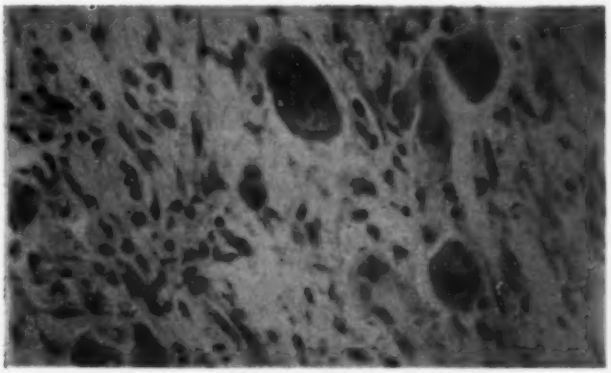

FIG. 605.—Reparative granuloma. Showing the phagocytic properties of the giant cells. (× 180.)

FIG. 607.—Ossifying fibroma. Showing the X-ray appearance of the specimen.

Other patients with osteosarcomata were in the older age group varying from 40 to 60 and all had similar histological appearances. The interest of the other cases was the association of this type of tumour with generalized Paget's disease of bone and

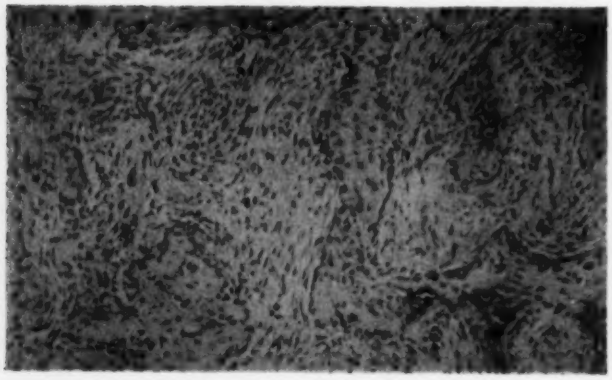

FIG. 608.—Ossifying fibroma. Showing a cellular fibrous tumour with areas of active ossification. (× 40.)

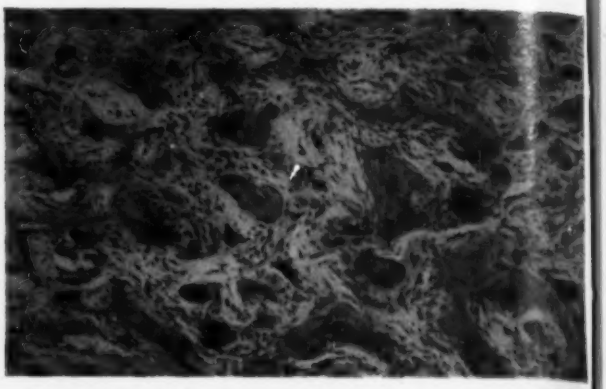

FIG. 609.—Ossifying fibroma. Showing areas of ossification in a cellular fibroma of bone. (× 40.)

the universally poor prognosis by all methods of treatment in that there is not one long-term survivor.

Chondroma.—The chondroma is a rare tumour in the jaw, and it has been suggested that vestigial cartilage cells in the jaw bones form the nidus for eventual tumour formation (*Fig.* 598). *Fig.* 599 shows a benign cartilaginous tumour involving the root of a tooth (*Fig.* 600) which was slowly growing and which, following the local removal, has given rise to no further trouble.

Chondrosarcoma with Paget's Disease of Bone.—*Fig.* 601 shows the radiograph of a tumour arising in the mandible of a 65-year-old man with Paget's disease of bone. A biopsy of the area revealed a chondrosarcoma (*Fig.* 602), but no resection was undertaken as he was found to have secondary tumour deposits in the lung at the time of diagnosis. A palliative course of irradiation was undertaken, but the patient died six months later.

Chondrosarcoma with Survival.—A man aged 38 developed a chondrosarcoma of the maxilla in 1946. The biopsy revealed a similar histology to the previous case, but there was no evidence of associated Paget's disease. The tumour was locally excised, but recurred at the operation site. In 1948 a more radical procedure was performed and the patient has remained alive and free from recurrence to date. This case is the only one in the series to survive and the other cases treated by irradiation have all proved fatal, the tumours showing properties of both local destruction and blood dissemination.

Giant-cell Lesions.—The true giant-cell tumour of the jaw is rare in contrast with the frequency of other, but totally unallied, lesions of the jaw which histologically contain multinucleate giant cells. Osteoclast-like cells are found in a large variety of non-neoplastic conditions of the jaw, including

FIG. 610.—Showing the X-ray appearance of the tumour in the frontal region.

FIG. 611.—Showing the cellular spindle-cell tumour with spheroids of partially calcified bony material. (× 50.)

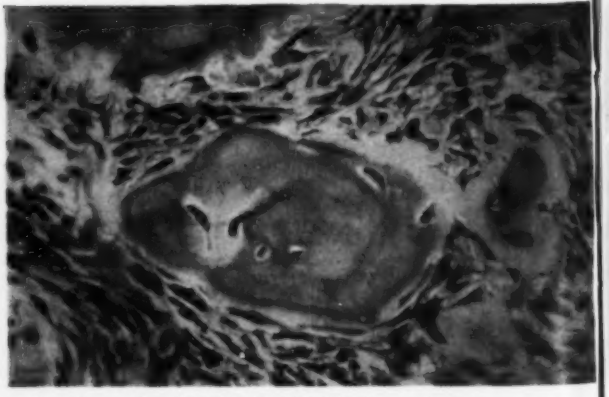

FIG. 612.—Showing the detailed histology of the tumour as *Fig.* 611. (× 180.)

giant-cell epulis, fibrous dysplasia, osteitis fibrosa cystica, and reparative granuloma (Jaffe, 1953).

Jaffe (1953) has recently stressed the frequency with which a reparative granuloma in the jaw is confused with giant-cell tumour. *Fig.* 603 shows a radiograph of the jaw lesion in a patient aged 28. A biopsy from this area shows a fibroblastic stroma with some spindle-cell areas in which there are spicules of osteoid tissue formation (*Fig.* 604). In addition there are giant cells present, but they are not as numerous as in a giant-cell tumour and they are frequently phagocytic, containing droplets of

FIG. 613.—Fibrosarcoma. Showing a pleomorphic fibrosarcoma with collagen formation. (× 40.)

fat (*Fig.* 605) or red corpuscles. The differences, therefore, between a reparative granuloma and a giant-cell tumour on histological appearances are the comparative paucity of the giant cells with their phagocytic properties, the fibroblastic stroma, and the spicules of new-bone formation in the reparative granuloma. New-bone formation does not occur in the bone-resorbing giant-cell tumour and the stroma is much more cellular; thus a distinction between the progressive and aggressive tumour process and the self-limiting granuloma should be possible if the existence of both types of pathology is recognized.

The patient with the reparative granuloma described above and another female aged 20 with similar radiological and histological appearances were both treated by irradiation to a dosage of less than 2000 r. Following this small amount of irradiation the lesions sclerosed and both patients have remained well and free from further trouble for 10 and 12 years respectively.

It is important therefore to recognize that giant-cell tumours are rare compared with the frequency of other giant-cell-containing lesions, including the reparative granuloma, which may give clinical, radiological, and histological pictures which can be confused with the true tumour if other conditions are not carefully considered. It should further be emphasized that most of the lesions which contain giant cells within the bone are not true tumours and have an excellent prognosis.

An Ossifying Fibroma.—*Fig.* 606 shows the mandibular swelling of a 22-year-old patient which radiologically (*Fig.* 607) reveals an area of central radiotranslucency in the ramus. The lesion was treated initially by curettage, but the tumour continued to expand and destroy the bone. It was therefore decided to excise the involved area of the mandible and the histology of the lesion shows destruction of bone by a cellular fibrous tumour in which there are areas of active ossification in its stroma (*Fig.* 608).

FIG. 614.—Plasmacytoma. Showing the jaw swelling.

An Ossifying Fibroma of Bone with Recurrence.—A man aged 30 developed a tumour of the right maxilla in 1932. This was removed by local resection. By 1936 the tumour had recurred and formed a mass bulging into the right maxillary antrum. Further operative removal was performed and the histology revealed an ossifying fibroma of bone (*Fig.* 609). The patient has remained alive and free from recurrence since.

An Unclassified Tumour.—The first case in this group was a boy aged 11 who was admitted to the Middlesex Hospital in 1925 with a swelling of the lower jaw, having given a history of a blow with a cricket ball six months previously. Pain was first noticed, and was followed by a swelling. On examination there was a hard enlargement of the right side of the mandible extending to the left of the symphysis menti and as far back as the angle of the jaw. The swelling also extended medially inside the mouth. A molar tooth was missing. A radiograph showed expansion of the bone—an appearance suggesting a dentigerous cyst. Histologically the tumour was seen to be composed of a spindle-cell stroma in which there were circular foci of partially calcified bone tissue. It was suggested that this tumour might be a variety of cementoma. Since this date we have seen 9 examples of this tumour, 5 arising in the maxilla, 1 in the mandible, and 3 in relation to the ethmoid or frontal sinuses. None

has been seen outside the skull. The radiological and histological appearances of this tumour are shown in *Figs.* 610–612, but, in spite of the obvious cellularity, the lesion appears slowly growing, although a wide local resection is necessary to prevent local recurrence of the growth. The precise histogenesis of this lesion remains in doubt and it has been likened to a cementoma and to fibrous dysplasia, although it seems more logical to regard it as a type of ossifying fibroma. The fact that the tumours occur outside the jaw bones weakens the argument that they are but variants of a cementoma.

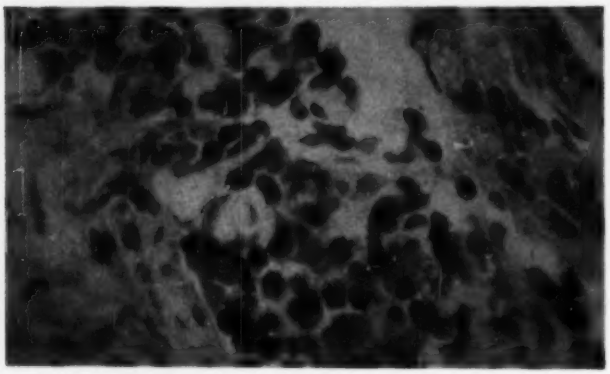

FIG. 615.—Plasmacytoma. Showing clumps of atypical plasma cells. (× 180.)

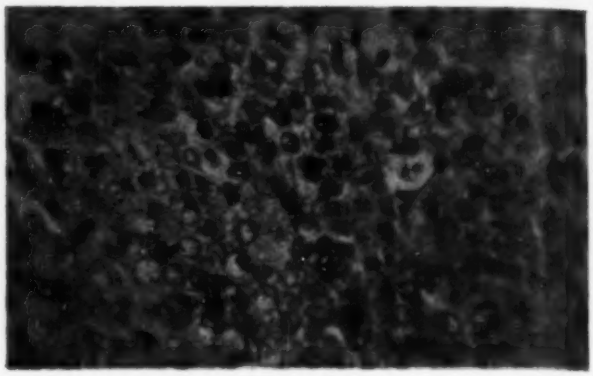

FIG. 616.—Reticulum-cell sarcoma. Showing an undifferentiated pleomorphic tumour. (× 230.)

A Fibrosarcoma with a Long Survival.—In 1939 a male patient aged 22 developed a swelling of the right mandible, which on biopsy showed a cellular and pleomorphic tumour with collagen formation indicative of a fibrosarcoma (*Fig.* 613). He was treated by one dose of irradiation, followed immediately by removal of the right mandible. Subsequently plastic repair of the operation site was performed and the patient remains alive and free from recurrence 18 years after the initial operation.

A Solitary Plasmacytoma of Jaw.—The mandible and maxilla are sometimes involved as part of a generalized multiple myelomatosis, but by contrast we have encountered a case of an apparently solitary plasmacytoma of bone arising in the mandible of a girl aged 18. She presented with a swelling of the right mandible (*Fig.* 614) which on radiography showed extensive bone destruction. A biopsy showed replacement of bone by atypical plasma cells (*Fig.* 615) and she was treated by a course of irradiation to a tumour dose of 8000 r followed by removal of the mandible. The patient has now had a plastic repair of the operation area and she remains alive and free from tumour recurrence seven years later.

Reticulum-cell Sarcoma of the Jaw.—A female aged 34 developed a tumour of the right mandible with bone destruction. Biopsy showed a pleomorphic undifferentiated malignant tumour, the appearances of which were entirely compatible with a reticulum-cell sarcoma (*Fig.* 616). She was treated by irradiation to a tumour dose of 5600 r and this was followed by bone sclerosis in the tumour area. She subsequently developed an enlarged liver with multiple deposits of tumour in the skeleton and she died a year after the initial diagnosis.

DISCUSSION

It would appear from the foregoing that although in most instances it is permissible to assign these jaw tumours to a proper classification, there are many examples where the real nature is in doubt although much is known of their behaviour. The amount of speculation as to their nature is an index of our lack of knowledge. It is hoped, however, that examination of the clinical and histological features combined with the follow-up in a sufficiently large number of cases will render their nature clear and enable us to give a prognosis.

With regard to the unclassified tumour, the histological appearances are characteristic and render this tumour easily recognizable. The cases we have seen have all behaved in a similar manner, i.e., they grow slowly, are easily separated from the surrounding tissue, and behave in a benign fashion. The importance of this tumour lies in its recognition and distinction from osteogenic sarcoma in view of its relatively benign character.

SUMMARY

A brief classification of swellings of the jaw is given and attention is directed to one or two unusual conditions.

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ULCERATIVE COLITIS

A REVIEW OF 36 PATIENTS TREATED BY OPERATION—WITH SPECIAL LONG-TERM RECORDS OF 12 CASES OF ILEORECTAL ANASTOMOSIS

By ALBERT E. COATES, Melbourne

Surgical treatment of ulcerative colitis is a recent development. Ileostomy had a doubtful reputation from the days when it was done for ileus and small-bowel obstruction. However, its practice for severe cases of ulcerative colitis soon proved its superiority to appendicostomy. A fairly typical case twenty years ago was the following, my first essay into surgery for this disease.

Miss S., aged 30 years, had been treated medically for several years, spending long periods in the Royal Melbourne Hospital.

1938: At the request of her physician, Dr. G. A. Penington, I performed an ileostomy. Great improvement in her condition followed.

1939: As she appeared to be deteriorating a little, I did a colectomy, leaving the rectum. That was fairly standard practice at the time; surgeons were feeling their way.

1947: She again consulted me and as the rectum was a rigid tube, ulcerated and full of pus, I excised it, leaving a permanent ileostomy. The opening is small and the patient has had a comfortable life for nearly twenty years. She is at present in good health.

During the war, in Japanese Prison Camps, we had many deaths from perforation of the colon as a result of amœbic dysentery. In a camp at Tavoy, in 1942, I did an ileostomy on a Dutchman, at his physician's request. He was very ill, grossly distended, and bleeding from the ulcers in the bowel. Experience had taught us that he was in a condition of pre-perforation. Post-mortem examination had disclosed that the disease never extended upwards beyond the ileocæcal valve. There was no emetine or other drug available for treatment. The patient wore a Dutch water bottle over his ileostomy for the next three years and, after the war, he was given a course of anti-amœbic treatment and I closed his ileostomy.

A record of these cases is given elsewhere (Coates, 1946). Suffice it to say that some of us gained some experience in the operation and it was not surprising that, on return home, we should have had patients requiring surgery for ulcerative colitis referred to us.

With the advances in anæsthesia, and in restorative treatment, it has become possible to perform colectomy and, in some cases, total proctocolectomy at the primary operation.

With fewer moribund cases being referred for surgery, and with the aids we now have, a much bolder attack can now be made at the initial operation. Primary colectomy is the operation of choice, for by that means the large ulcerated surface of colon still capable of toxic absorption, and resembling a necrotic or burnt area of skin, is removed at once. Six of my patients were so ill that I did the colectomy in two stages. They all survived and are now well, though they have permanent ileostomies. However, I believe that there is a place for a preliminary ileostomy in certain cases—not the fulminating or heavily bleeding cases, of course, but the debilitated patient with perhaps a near perforation.

The immediate mortality in the 36 cases:—

1. Pyelephlebitis—a man of 45 who died ten days after colectomy.

2. Subphrenic abscess following colectomy—a girl of 20.

3. Bronchopneumonia—a lady of 37.

4. Thrombosis of mesenteric vessels—a male of 25 who had uncontrollable bleeding from the colon, necessitating urgent primary colectomy.

5. Small-bowel obstruction caused by catching a coil in a spur at the time of crushing.

Three of these deaths were probably preventable. They all occurred in the earlier group of patients. The third one could have occurred in any case. At post-mortem examination, the liver was seen to be in a state of gross fatty degeneration. The patient had had an ileostomy and colectomy done when very ill two years before and her death followed an operation for removal of the lowest part of the sigmoid. Her ileostomy had given her great anxiety; it discharged very freely and her electrolytic balance was upset. She pleaded to have the ileum and rectum joined, but the latter was not considered healthy enough.

This brings me to the main theme of this paper—i.e., the place of conservative surgery in ulcerative colitis. By conservative surgery is meant the preservation of the rectum and, in suitable cases, the re-establishment of the alimentary canal by ileorectal anastomosis.

Despite the fact that a permanent ileostomy is tolerated by most patients quite well (in fact one of my patients having a permanent ileostomy recently had twins and called each one by one of my Christian names), it is true that a few patients find ileostomy life a burden.

The thought of permanence in the ileostomy is a great shock to some nervous patients and especially to their parents.

Such a patient, Miss F., aged 16—under medical treatment for two years—perforated the cæcum. Urgent operation—ileostomy and hemicolectomy—followed later by left colectomy. Rectum retained. Her parents dreaded the ileostomy as a permanency in their beautiful daughter. For five years, regular examination of the rectum was done and the parents hopefully waited. Then the girl, now having developed into a strong-minded young woman, requested excision of the rectum. This was done—the girl is now on a tour of England. She enjoys sport, including swimming.

One-half of my series have had or will have the rectum excised. One-third have had ileorectal or lower colon anastomosis. The rest are dead. The criteria for preserving the rectum and hoping for a later anastomosis are: ulceration must be less

marked in the rectum, some elasticity be present, the valves should be intact—in other words the rectum should be a container and the patient should be in the younger age group. That it does improve in appearance after the colon has been removed is true in some cases, not in all. Therefore, a policy of waiting is justified.

Total proctocolectomy is, of course, the procedure I have adopted in patients who have fistulæ (recto-vaginal, 2 cases ; ischiorectal, 2), strictures, polyposis, or carcinoma. Delay in such cases is bad.

Three of my patients are waiting and hoping that the rectum will improve sufficiently to allow of joining them up, but I am afraid they will wait in vain.

The record of patients who have had colectomy and then ileorectal anastomosis is appended. No plea is made on behalf of this form of treatment.

Each case was judged on its merits and the local rectal condition as well as the patients' wishes carefully weighed.

This series of patients has been operated on by myself and notes kept by me. The follow-up also has been personally done by me. It does not include patients who have been seen in consultation privately or for the Repatriation Department and not personally operated on by myself.

The following questionnaire was sent to each patient and a sigmoidoscopic examination performed in March, 1957. Replies were received from all and seven were examined by me :

" Since your ileostomy was closed—

a. How is your general health ?
b. Have you gained weight ?
c. How many motions a day ?
d. Do you pass blood ?
e. Have you any abdominal pains ?
f. How many attacks of diarrhœa ?
g. Have you any other complications ? "

CASE REPORTS

Miss J. S., aged 13 years.—Referred by Dr. Lawrence Stokes, pædiatrician, July 28, 1948. For four years had nine or more blood-stained stools per day. In hospital for two years, most of the time, both in Sydney and Melbourne. Under the care of Dr. Lorimer Dods, Sydney.

On examination, a shrunken child about 4 st. in weight, passing frequent foul-smelling stools—mucus and blood. Organisms—Streptococci and B.C.C.

Sigmoidoscopy : Mucosa of rectum—spongy and prolapses easily—but no ulcers seen.

Barium clysma : Ribbon-like colon—no haustration. Typical of ulcerative colitis.

Aug. 4, 1948 : At Epworth Hospital, ileostomy done through the right lower rectus muscle. The ileum was thick-walled in its last 18 in. The ileostomy was made proximal to the thickened area.

During the subsequent week or two, she was seen by Mr. Rupert Corbett, of London, in consultation (he being in Melbourne at the time).

Sept. 23 : Colectomy and enterostomy—from site of ileostomy to lower sigmoid. The ileostomy and the stump of the sigmoid were laid together and exteriorized in the suprapubic region. Pathologist report : " Lower ileum thick and ulcerated. Greatest disease in cæcum and ascending colon ; lower colon, œdema and scarred mucosa."

The patient recovered well, except for the development of an abscess in the right iliac fossa—at the site of the heavily infected cæcum.

Feb. 22, 1949 : The spur had been crushed and the anastomosis was closed, as is done in closing a colostomy.

Dec. 12 : Five stools a day. Weight 8 st. ¼ lb. No blood. At school.

The progress of this patient has been steady. She completed her schooling, indulged in the usual sports, and was married in May, 1957.

Her weight varies between 9 and 10 st. (9 st. 10 lb. in March, 1957). She is 5 ft. 10 in. in height and a splendid specimen of Australian womanhood.

Replies to questionnaire : General health excellent. Weight gained. Six stools a day, no blood. No abdominal pain. One attack of diarrhœa last year during a menstrual upset, the only attack since 1948. No other complications.

Sigmoidoscopy : Some mucus, trace of blood. Mucosa velvet-like—no ulcers. No blood in stool. Valves elastic.

Barium clysma, November, 1956 : " The contrast medium passed freely through the remaining segment of colon and entered the ileum. No evidence of pathological changes in this portion of the bowel, the bowel emptying being almost complete."

Comments.—This patient appeared suitable for the operation performed. She is intelligent and will have regular examination by sigmoidoscope and clysma. Fortunately, the main evidence of the disease was in the right colon and lower ileum.

G. M., a male, aged 15 years.—Referred by Dr. Glyn White, July 24, 1947. Ulcerative colitis since childhood. A sick-looking boy.

Sigmoidoscopy : Gross ulceration, rigid cæcum.

Barium clysma : Drain-pipe colon—no haustration.

Aug. 1, 1947 : Blood transfusion given because of anæmia. Ileostomy was done 18 in. from the ileocæcal valve (Freemasons' Hospital).

Sept. 20 : Sigmoidoscopy—slight ulceration of rectum, pus and blood coming from colon above.

Dec. 5 : Subtotal colectomy done plus the ileum to 6 in. above the ileostomy. The cut end of ileum and lower sigmoid were laid together in the usual double-barrelled fashion.

PATHOLOGICAL REPORT.—Many pseudo polyps in the colon. Typical ulcerative colitis.

Dec. 31 : Spur crushed.

March 16, 1948 : *Sigmoidoscopy* : Rectal mucosa soft and pink ; no ulcers seen. Stool in rectum firm. Weight gained 6 lb.

July 6 : *Sigmoidoscopy* : Rectum not yet healed—bleeds easily on contact, rigid tube. To leave ileostomy open.

July 7, 1949 : Ileocolic anastomosis completed. Wounds closed. Returning to school.

Feb. 9, 1951 : Nine stools a day. Mucosa of rectum swollen and œdematous—no ulcers seen. No blood in stool.

Jan. 4, 1954 : Eight stools a day—now working normally. Rectum healed. No ulcers. A tender area at site of anastomosis.

Jan. 14 : Small abscess in old scar incised.

Jan. 19 : A sinus healing.

March 26, 1957 : General health good. No loss of time from work. Six stools in 24 hours. No blood. Weight 10 st. 4 lb. No abdominal pain. Anal spasm at times. No other complications. Looks a healthy young man. Works as a methods engineer or efficiency expert. Sails boats as a hobby.

Sigmoidoscopy : Pink velvet-like mucosa of rectum. No ulcers seen. Solid stool in rectum. Anastomosis visible. Ileum inspected. Normal appearance. When his stools are loose, he takes enterovioform.

Comment.—This young man of 26 had a stormy adolescence—a highly sensitive boy in a home with some

domestic disharmony, he has succeeded well in his studies and now enjoys his work. He is very pleased with his physical state.

It is to be noted that at the time colectomy was done, the rectal condition did not look promising. Two years elapsed before the final closure was done. The rectum is now much more normal than when first seen by me in 1947.

Mrs. M., aged 27.—Referred by Dr. Dungan.

May 9, 1947: For 5½ years diarrhœa with blood. Usually ten stools in 24 hours.

Sigmoidoscopy: Gross ulceration of the rectum.

Barium clysma: Typical picture of ulcerative colitis.

The patient had been confined to bed for varying periods and had been given the usual medical treatment. She was losing weight and could not attend to her household duties.

June 14: Ileostomy performed. The ileum was swollen and distended in its lower 9 in. The ileostomy was done 18 in. from the ileocæcal valve.

November, 1947: Subtotal colectomy was done at the Royal Melbourne Hospital. The sigmoid colon was divided low down in the pelvis and the distal stump brought out of the lower end of the paramedian incision—together with the ileostomy. The spur was crushed some weeks later and the anastomosis completed. During the next two years she had two attacks of small-bowel obstruction which were relieved by operation. In each case a band was divided between a coil of small bowel and the stump of the mesocolon.

Small abscesses form in the divided lymph-glands in the mesocolon and are a cause of this complication.

Because of some menstrual disorder, she was sterilized by radiotherapy in 1954.

Feb. 19, 1957: In answer to the questionnaire: General health good. Gained 1 st. in weight in last six months (she is now quite plump). Six stools in 24 hours. Very occasionally, a tinge of blood when she has attacks of diarrhœa. Some abdominal pains at times. Has had many mild attacks of diarrhœa in the past ten years. Attacks last 2–14 days. Other complications occasional cystitis, gynæcological upset cured by deep X-ray therapy.

Sigmoidoscopy: Solid stool in rectum. Mucosa pale pink. No polyps. No ulcers, no bleeding. Valves normal. Her rectum appears normal. A recent barium clysma showed no abnormality. She leads a normal life as a housewife—has the appearance of a healthy little woman. She is very pleased with her condition.

Comment.—This patient illustrates the dangers of small-bowel obstruction after colectomy for ulcerative colitis. In 6 other patients of the 35 subjected to colectomy, this complication has occurred; in 1 it was fatal. It is not so much the denuded area in the colic gutters which cause trouble as the cut stump of the mesocolon as mentioned above.

Mr. R. D., aged 24.—Referred by Mr. E. E. Dunlop, Feb. 4, 1946. Diarrhœa for sixteen years; in and out of hospitals—on medical treatment.

A frail young man. Sigmoidoscopy—reddish mucosa—some scars—no ulcers seen.

X-ray Examination:—"Typical ulcerative colitis."

Ileostomy done—followed by total colectomy and anastomosis of ileum to rectosigmoid stump—intrapelvic. (Not a good operation.) The colon showed the typical picture of ulcerative colitis—in addition there was a cauliflower growth—carcinoma in the transverse colon.

July 20, 1948: Weight increased (12 st.)—very well.

Sigmoidoscopy: A few tiny ulcers high up—mucosa reddish.

March 16, 1949: Sixteen stools in 24 hours. Desires permanent ileostomy.

May 18: Twelve to fifteen stools a day. Ileostomy reconstructed in right iliac fossa.

Feb. 14, 1951: Is very well—weight 13 st.—but ileostomy troublesome—ulceration around it, extending deeply into the abdominal wall. A skin-covered piece of ileum was made by a plastic surgeon, but sloughing occurred. For several months he was in the Royal Melbourne Hospital. The ulcers of the abdominal wall spread—as in cases of symbiotic gangrene. Culture grew streptococci. All attempt to clear up the ulcers of the abdominal wall were unsuccessful. Psychiatric treatment unsuccessful.

After my return from England in 1951, I excised his ulcers and removed the sigmoid stump, joining the end of the ileum to the lateral wall of the rectum just above the peritoneal reflection (end to side).

Feb. 26, 1952: He enjoyed good health. Abdominal wall well healed. Eight stools in 24 hours. Some irritation of the rectum. He appeared very well and thanked me for all the attention he had received. Arrangements were made by me to place him in a suitable position in Melbourne so that he could continue studies and improve his position. In 1955, I learned that he had died in a country hospital—an acute abdominal emergency—perforated duodenal ulcer.

Comment.—This patient taxed the resources of surgery. He could not tolerate an ileostomy—the spreading ulceration of the abdominal wall was not fully explained. The reconstitution of the ileorectal anastomosis was successful. There was no evidence of recurrence of the carcinoma of the colon in nine years.

Mr. H., aged 54 *years.*—

Nov. 25, 1947: Referred by Dr. Leslie Hurley and Dr. Morgan. Treatment in Geelong and Melbourne. Six loose stools a day.

Sigmoidoscopy: Typical ulcerative colitis—confirmed by barium clysma. A thin ageing man.

Feb. 16, 1948: Ileostomy done, followed by colectomy on March 16. Double-barrelled arrangement of lower sigmoid and ileum. A severe biochemical disturbance followed—great quantities of fluid being lost—electrolytic balance upset. Because of his age and risk of trouble in the rectum, I advised excision of the rectum and permanent ileostomy. He refused to have this done; he could not manage the ileostomy well, and was constantly worried about it; even more so, was his wife. The skin around the ileostomy was eroded and he requested closure.

Feb. 9, 1951: Barium clysma was done. "Free flow without evidence of obstruction from rectum to the opening—margin clearly defined—no gross ulceration present, lumen of bowel diminished."

Sigmoidoscopy: Thickened mucosa—no ulcers. Because of his importunity, I reopened him at the Royal Melbourne Hospital, excised the remains of the sigmoid colon and joined the end of the ileum to the side of the rectum. He made an uninterrupted convalescence except for some infection of the abdominal wound.

Jan. 7, 1952: Six to eight stools in 24 hours—no blood. Rectum appeared clear.

In Reply to Questionnaire.—

General health—vast improvement. Gained 3½ st. in weight. Ten stools in 24 hours. No blood. Occasional twinge of abdominal pain. Occasional diarrhœa.

The only complication is intertrigo because he is so fat. He is 64.

Sigmoidoscopy: Velvety rectal mucosa—no ulcers. Firm anal muscles as if sphincter were hypertrophied. Valves normal. Stool as ileal content. No blood seen.

Comment.—This elderly patient could not tolerate ileostomy. He has been happier and healthier since the ileorectal anastomosis. He is able to work normally.

Mrs. E. W., aged 39 years.—Referred by Dr. Bouvier.

Nov. 5, 1945: Under medical treatment at the Royal Melbourne Hospital for 2½ years for ulcerative colitis. Loss of 3 st. in weight during last year. Seven stools a day—some blood; foul smelling. Pains in abdomen. (Sigmoidoscopy: Barium clysma 2½ years ago.) Typical ulcerative colitis.

Nov. 5, 1948: Sigmoidoscopy: Rectum fairly clear.

December: Ileostomy followed by subtotal colectomy and exteriorization of stomata.

March, 1950: Closure of ileorectal anastomosis.

July, 1952: Repair of incisional hernia in suprapubic region. Seven stools a day. The excised colon showed typical ulcerative colitis. The rectum was the least affected. During the years since, she has done her housework and, in addition, is an active voluntary worker for the Red Cross. I heard from her two years ago and she was then very well. She has since left the State.

Mrs. P., aged 23 years.—Ulcerative colitis for several years, under medical treatment. A worried home life.

Ileostomy done in 1945 at Royal Melbourne Hospital by Mr. Paul Jones. At the time she was a very sick, wasted girl.

July 21, 1948: Subtotal colectomy by A. E. C. Weight 9 st. 7 lb.

Oct. 21: Spur crushed and closure of anastomosis a few weeks later.

Aug. 18, 1949: "Feels marvellous." Two stools a day.

Oct. 3: Incisional hernia of original ileostomy repaired.

April 17, 1950, *Sigmoidoscopy*: Stool semi-solid. No ulcers. Weight 12 st. 7 lb. Too fat.

June 6, 1950: Loose stools—four a day—no blood. Pus in rectum.

July 16, 1951: Has lost some weight—two stools a day.

Sigmoidoscopy: Mucosa thick—bleeds on contact.

May 18, 1954: Domestic worry. Diarrhœa and blood. Ulcers seen in rectum. R_x Sulphaguanadine.

June 15: Much better. Three stools a day. Normal domestic relations. Had a recent miscarriage.

Mar. 11, 1955: Six months pregnant—very well. Three to four stools a day.

Sigmoidoscopy: Slushy stool—no ulcers.

Feb. 8, 1957: "Wonderfully well." Baby 15 months old. Had some diarrhœa at time of delivery—none since. No abdominal pain. No blood in stools—two a day.

Sigmoidoscopy: Dark red mucosa—rectum capacious. Valves visible—no ulcers. Stools formed. Weight 9 st. 9½ lb.

Comment.—This lady, now 35 years of age, enjoys a happy home life and is very pleased with her condition. It is of interest that this patient reacted violently to domestic worry. However, great improvement in the rectum has been observed in the years since ileorectal anastomosis was done.

Mr. T. C., aged 15 years.—A thin young man. Twenty stools a day. Lost 1 st. in weight.

February, 1948: Ulcerative colitis for several years. Referred by Dr. Leslie Hurley for surgery at the Royal Melbourne Hospital.

Ileostomy done. General condition improved. Two months later, total colectomy done with closure of rectal stump.

May, 1951: End-to-side anastomosis of ileum to rectum.

Feb. 12, 1957: Is now very well. Married—has a child of 3. Loses no time from work. Works in explosives factory. Five stools in 24 hours—very rarely a trace of blood. Very occasional abdominal pain. Weight 10 st.

Sigmoidoscopy: Pale pink mucosa of rectum. Valves competent. No ulcers. Stool firm. Anal sphincters hypertrophied. A normal looking young man.

Comment.—The whole colon was removed in this patient. He is very happy with the result.

Mr. F. N., aged 35 years.—Taxi driver. Ulcerative colitis for 10 years.

Jan. 18, 1952: Had a colostomy done in another State 4½ years ago. Diet, washouts, etc. Much medical treatment. Ileostomy then done. Prolapse and gangrene of ileum—amputation of prolapsed bowel. Two further prolapses of ileum through stoma. Treated in another State.

Sigmoidoscopy: Ulcerated rectum, pus and blood present. I advised colectomy, but he insisted that he could not carry on his work wearing an ileostomy bag and requested that an ileorectal anastomosis be done. At Royal Melbourne Hospital (March 1952) total colectomy done, ileostomy excised, and a new one made. Two months later, ileorectal anastomosis done.

Nov. 28, 1956: He is very well. Healthy looking man—four stools a day, 1 at night. No blood. Drives his taxi and is very happy.

Sigmoidoscopy: Rectal mucosa of velvet texture, no ulcers, no blood seen—but rectal mucosa bleeds if abraded. No polyps. No pus. Stools soft. He paid a special visit from his home 1500 miles away to attend the Olympic Games and to thank me. "He had given up hope", but is now very grateful for his operation.

Comment.—The appearance of the rectum was very different from what was observed in 1952 when pus and blood were present.

Miss E. T., aged 18 years.—Ulcerative colitis for four years. Very ill, 1947. Ileostomy—followed by subtotal colectomy three months later. Spur crushed and anastomosis completed. The following year she entered a nursing course at the Children's Hospital. Some doubts were expressed by the examining officer, but these were allayed by myself because of the great improvement in the girl. After completion of her training, she married a clergyman in 1956.

In reply to my questionnaire, 1957, she reports that she is very well, has four or five stools a day—no discomfort. I have not examined her rectum as she lives in the country and finds it inconvenient to visit the city. She is a grateful patient who sends me Xmas greetings each year.

Mrs. O'C., aged 32 years.—Four children. Referred by Dr. Arthur Lewis, Kyogle, N.S.W.

August, 1953: As a child "weakness in the bowels".

At 14 years: Peritonitis—? cause. At 24, diarrhœa with blood and slime. Episodes in 1952 and 1953—very severe. Twelve stools a day. Left-sided pain. Weight—losing. X-ray picture typical ulcerative colitis.

Sigmoidoscopy: Typical changes in lower sigmoid and upper rectum—lower rectum not so bad. Advised colectomy with probability of joining up ileum to rectum.

Aug. 24, 1953: Subtotal colectomy. Double-barrelled arrangement of ileal and sigmoid opening. Three weeks later, an abscess which formed in the mesocolon stump was drained, in the left flank.

May 26, 1954: Closure of ileorectal anastomosis.

June 30: Sigmoidoscopy—no blood—fluid stool.

In a letter, Feb. 17, 1957: "Dear Sir, Am pleased to be able to pass on a really good report. I don't remember feeling better than I have done for the past 18 months. My life is very active and my time fully occupied.

"In the matter of passing blood and diarrhœa, they have occurred twice when eating onions or tomatoes, so I watch my diet. The motions are firm—four to six a day. I wish it were possible for me to call and see you,

but it is such a distance. . . . My doctor and chemist, beside my friends, often remark on the remarkable result of the operation. . . . My deepest thanks to you again and hope that many more may be helped likewise."

Case number 12, which completes the series of those anastomosed, was operated on in 1946, ileostomy being done. Some months later, colectomy was done and the ileum joined to the rectum within the pelvis. She developed a pelvis peritonitis, a subphrenic abscess, and died (included in the mortality list). I abandoned this method of anastomosis and have since done the Devine modification of the Mikulicz exteriorization, or closed the rectal stump and at a later operation joined the ileum to the rectum when inflammation had subsided.

R. E., a boy aged 14 years, but having the appearance of a lad of 11 years. Suffered from ulcerative colitis for three years. Referred to me by Dr. G. A. Penington. Sigmoidoscopy revealed some bleeding, mostly coming from the colon—radiograph indicated that the more serious lesion was in the cæcum and ascending colon. After a blood transfusion (3 pints), a primary colectomy was performed—leaving the ileostomy opening alongside the stump of the colo-rectum. Within four days the ileostomy discharge was thickened—only three or four in 24 hours, and he went home 14 days after operation. The rectum is retained and will be watched for the probable anastomosis in three or four months.

There are 10 out of 12 survivors of the operation (1 died of causes other than ulcerative colitis). It is pleasing to note the general health of 7 that I examined personally in 1957 and to hear from the other 3 survivors the news of continued good health and freedom from serious rectal trouble.

They have all been warned to seek surgical advice if bleeding should occur or if serious diarrhœa, loss of weight, or abdominal pain should occur. They have also been advised to have the rectum examined visually from time to time.

DISCUSSION

A review of 36 patients treated surgically for ulcerative colitis has been given. No attempt has been made to analyse in detail the course and result in all the patients. Half of them were treated by the radical operation, total colectomy and excision of the rectum. As this is fairly standardized, in fact, in most surgical circles regarded as the only respectable operation, it was not necessary to detail those cases. It may be noted that excision of the rectum at the primary colectomy is easier than doing it later when perirectal fibrosis is marked.

However, the preservation of the rectum has some merit, in my opinion, and I would prefer to delay an opinion of its recoverability. Some most unpromising rectums have been salvaged in the above series.

On the other hand, my experience, while small, differs from that of Aylett (1957), who has a most impressive series of ileocæcal anastomoses to his credit. I agree with Aylett that there is some evidence of improved rectal health after total colectomy and the lower this is done the better (*see Cases G. M., R. D.*).

Of 36 patients subjected to colectomy for ulcerative colitis, 12 had an ileorectal anastomosis. Ten of them are still alive (1 died post-operatively, first in the series, the other died of other disease). The 10 patients are aged from 22 to 64 years—4 males and 6 females. Seven of them have enjoyed good health for ten years since the ileum and rectum were joined, the other 3 for a shorter period.

The thirty-seventh case is too recent to include in long-term results.

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THE MANAGEMENT OF ACUTE CHOLECYSTITIS

BY ALAN E. LEE, BRISBANE

THIS paper is dedicated to Sir Gordon Gordon-Taylor, in grateful acknowledgement of the support he has given, during his periodic visits to Australia, to the writer and his surgical colleagues, to persist with the methods of management to be described. In support of these methods, statistics will be presented of the experience in diseases of the gall-bladder and biliary tract (excluding neoplasms) in the wards of the Brisbane Hospital (a general hospital with an average of 1400 occupied beds, serving a population of about 500,000) for the year ending June 30, 1956; and also the certified deaths from these diseases during 1956 in the State of Queensland (population 1,350,000).

Surgical visitors have constantly noted the high proportion of patients with biliary tract diseases in Australian hospitals, even though the incidence of gall-stones in the population does not seem to differ significantly from that reported in Great Britain and North America. This concentrated experience has produced a concept of the relationship of these diseases which is simpler than that usually expressed in British text-books.

BILIARY TRACT DISEASE

We believe the usual pathological sequences to be as follows :—

1. The primary gall-stone, forming in the normal gall-bladder in the first five decades of life, as the result of a temporary derangement of function of as yet uncertain origin.

2. Acute cholecystitis (or occasionally mucocele), supervening on acute obstruction of the gall-bladder outlet, in about 95 per cent of cases due to an impacting gall-stone, with inflammation distal to the obstruction produced by the chemical irritation of bile substances absorbed into the gall-bladder wall and reinforced sometimes by bacterial infection.

3. The secondary, or post-inflammatory gall-stone, developing after the re-entry of bile into the

inflamed gall-bladder, when the highly viscid exudate produced by the inflammatory process can bind together precipitated bile constituents.

4. Repair after acute cholecystitis, mainly fibrotic replacement of destroyed gall-bladder tissues, with varying degrees of stenotic contraction.

5. Stones in the common or hepatic ducts, initially, apart perhaps from some rare hæmolytic diseases, always formed in the gall-bladder, from which one or more pass into the ducts, where more stones can be produced in the presence of obstruction.

There may be related cholangitis, and repair may lead to stricture formation, in the papilla or the ducts.

6. Stenosis of the duct system, related to operative injury, irritation of extravasated bile, or repair after repeated cholangitis.

These pathological conditions produce only three basic syndromes :—

a. Biliary colic, a deep pain of obscure and probably multiple origins, typically described as lower sternal in position, or sometimes also as a posterior pain between the tips of the scapulæ, or as a girdle of pain embracing these areas ; or if there is sufficient associated projected neuralgia, the pain may seem to be limited to the right subcostal areas of the 8th and 9th thoracic dermatomes.

b. The symptoms and signs of acute cholecystitis, which after the initial colic, apart from mass formation, are entirely related to the pericholecystic spread of inflammation to the duodenum (reverse peristalsis, nausea, vomiting), transverse colon (right colonic distension, lower abdominal pain, sometimes diarrhœa), abdominal wall (localized pain, tenderness, and rigidity), and gastrohepatic omentum (duct compression, jaundice).

c. Ductal obstruction, usually intermittent, and manifested by pain, fever, jaundice, or combinations of them.

This viewpoint stresses the importance of gall-stones rather than the state of the gall-bladder wall in the production of symptoms. Except in rare cases no symptoms are attributed to the results of repair after inflammation (the ' chronic cholecystitis ' of British authors), nor is it believed that dyspeptic symptoms are produced by biliary tract disease or gall-stones. Till their initial colic these are peculiarly eupeptic individuals, and the subsequent indigestion and fat intolerance has an anxiety basis, often doctor-induced.

If these are the syndromes, the aims of treatment must be the relief of pain, and the prevention or control of acute cholecystitis and ductal obstruction.

Results of Treatment.—In the year ending June 30, 1956, there were discharged from the wards of the Brisbane Hospital 691 patients classified as suffering from diseases of the gall-bladder and biliary tract (non-neoplastic). During the same period 2 patients were discharged with the diagnosis of carcinoma of the gall-bladder.

These 691 patients can be classified as follows :—

	Cases
Acute cholecystitis as initial evidence of gall-bladder disease	130
Acute cholecystitis with prior symptoms of biliary tract disease	136
Stones in the gall-bladder and/or biliary colic	324
Common-duct stones (gall-bladder present)	57
Post-cholecystectomy stones or ductal obstruction	44

The form and mortality of treatment was as follows :—

Acute cholecystitis (266 cases) :—
Medically treated, 247—3 deaths (*a*, *b*, *c*)
Surgically treated, 19—1 death (*d*)
Cholecystectomy before discharge, 86—4 deaths (*e*, *f*, *g*, *h*)

Gall-stones and/or biliary colic (324 cases) :—
Medically treated, 126—no deaths
Surgically treated, 198—1 death (*i*)

Common-duct stones (57 cases) :—
Medically treated, 23—4 deaths (*j*, *k*, *l*, *m*)
Surgically treated, 34—4 deaths (*n*, *o*, *p*, *q*)

Post-cholecystectomy stones or duct obstruction (44 cases) :—
Medically treated, 18—no deaths
Surgically treated, 26—no deaths.

Age and cause of death :—
a. 74, cerebral thrombosis.
b. 80, coronary occlusion.
c. 78, perforated gangrenous gall-bladder,—bile peritonitis.
d. 67, bile peritonitis.
e. 65, pulmonary embolus.
f. 78, bronchopneumonia.
g. 79, biliary cirrhosis—decubitus ulcer.
h. 74, subarachnoid hæmorrhage—pulmonary atelectasis.
i. 68, pulmonary embolus.
j. 80, cerebral vascular accident—recurrent cholangitis.
k. 96, congestive cardiac failure—multiple duct stones at autopsy.
l. 86, acute cholangitis.
m. 79, pneumonia.
n. 73, cholangitis, pyogenic meningitis.
o. 79, bronchopneumonia.
p. 74, cerebral thrombosis—recurrent cholangitis.
q. 67, malignant hypertension.

Though 17 deaths may seem a substantial number to be related to the biliary tract in one hospital in a single year, the following table shows a rather amazing situation.

	Ages at Death			
	0–60	60–70	70–80	80–100
Medically treated	—	—	3	4
Surgically treated	—	4	6	—

In a community where the average expectation of life in males is 67, and females 72, the average age at death of medically treated patients with biliary tract disease was 82, and that of surgically treated patients was 72.

If one were inclined to argue on the same basis as that by which the relation of cigarette smoking to carcinoma of the lung has been postulated, it might be said that the possession of gall-stones and especially of stones in the biliary ducts seems an important cause of longevity in the Queensland community ! In not more than 6 of these 691 patients was the cause of death directly related to diseases of the biliary tract, but rather represented the hazards of degenerative diseases when illness afflicts aged persons.

The actual risk to life in 266 cases of acute cholecystitis was represented by two open perforations of the gall-bladder, both fatal ; while intermittent ductal obstruction due to stone was compatible with extreme old age, and was still associated with a hospital mortality of only 8 deaths in 101 patients, of which only 4 were directly related to the biliary tract.

These figures fail completely to support any argument that the possessors of gall-stones, of whom no more than 5 per cent in the community will ever undergo cholecystectomy, need expect their gall-stones to shorten significantly, if at all, their normal expectation of life.

TREATMENT OF ACUTE CHOLECYSTITIS

When a patient with acute cholecystitis enters hospital, the decision to adopt surgical rather than medical treatment must rest on one or more of the following bases :—

1. That all biliary tract disease demands operation.

2. That an attack of acute cholecystitis increases the probability of future trouble, and is therefore an indication for cholecystectomy.

3. That since a patient with biliary tract disease has been forced into hospital, this is a convenient occasion for surgical treatment of the underlying disease.

4. That surgical treatment of acute cholecystitis is safer than medical management.

In the opinion of the writer none of these postulates is true, or at least each requires considerable reservation in its acceptance.

There is little doubt that the varying attitudes towards the treatment of acute cholecystitis are mainly determined by the degree of acceptance of the first of these propositions—that all biliary tract disease demands operation.

The proponents of this view, as expressed for example by Glenn (1957), stress the seriousness of gall-stones, in the sense of the increasing complications associated with their continued presence, the dangers to life in acute cholecystitis and ductal obstruction, and their deleterious effects on the heart, liver, and kidneys. In a recent Editorial, he concludes : "we believe that gall-stones whether or not associated with symptoms are a hazardous possession. Cholecystectomy may be deliberately embarked upon and under optimal conditions accomplished with an anticipated risk that is far less than those of the complications commonly associated with gall-stones in patients in the older age groups."

Though it is doubtful whether the acceptance of this advice is as widespread as published articles on the subject would suggest, it would be idle to deny that much authoritative opinion in Great Britain and the United States advocates the performance of cholecystectomy for all patients with gall-stones, irrespective of whether they are the source of discomforts.

These assertions are rarely buttressed by substantial statistics, and are completely contradicted by the figures from the Brisbane Hospital, where no patient in the absence of surgery died before the eighth decade and where the average age at death of these persons was considerably above that of the whole community.

Nor is the situation altered if the mortality rates, not for a single hospital but for the whole community, are studied.

During 1956, in the State of Queensland, excluding the Brisbane Hospital, 22 persons were stated in their death certificates to have had biliary tract disease (non-neoplastic) associated with their deaths (and no recent operation), and these deaths are shown in the table below.

	Ages at Death			
	0–60	60–70	70–80	80–100
Male	0	2	2	3
Female	0	4	8	3

Similar studies, if made in other countries, might well render untenable the present aggressive surgical attitude towards the possession of gall-stones.

To those who hold these views an attack of acute cholecystitis only serves as a recognition of biliary tract disease, with its indication for operation, which would only be postponed if experience had shown that this was a dangerous time to adopt surgical measures, as compared with the absence of inflammation.

But if a more conservative view is held as to the management of gall-stones, and especially if it is believed that the indications for surgical treatment are a succession of painful attacks which, *in the opinion of the patient*, justify a major operation for their control, the supervention of an attack of acute cholecystitis merely raises the question whether non-surgical methods of management should be continued, or whether prudence demands an operation for its relief.

The answers to this question as expressed in surgical journals are so various as to suggest that the severity of acute cholecystitis differs markedly in different countries and at different times.

Our own answer is clear, and the year's statistics showed that only 1 case of 147 cases of acute cholecystitis treated medically died of a direct complication of the disease, and only 1 case of 19 cases treated surgically showed a condition which in the absence of surgical treatment (and in spite of it) was likely to be fatal.

But Pribram, writing in Spivack's *Urgent Surgery* (1946), quoted German Clinics where medical management carried a 20 per cent mortality.

Becker, Powell, and Turner (1957) showed a 9·2 per cent mortality with conservative treatment between 1938 and 1946, which diminished to 3·8 per cent between 1947 and 1955.

Aird (1949) states, however, that "it seems certain that the mortality of an operation undertaken when toxæmia overwhelms an obese middle-aged woman is remarkably greater than the immediate mortality of acute cholecystitis. In the enormous majority of cases it is safe to delay operation."

Amongst proponents of early surgical intervention, Heuer, in 1937, reported 3·2 per cent mortality from emergency operations, and was convinced that the risk of operation is not so great as "the dangers of gangrene and perforation of the gall-bladder, the results of a conservative or waiting policy".

Walters, in 1939, reported 3·9 per cent mortality from emergency operations. DeCamp, Ochsner, Baffles, Bancroft, and Bendel (1952) reported 7·5 per cent operative mortality, and in the discussion after this paper, Ochsner was quoted as saying that he was confused on the question whether to operate immediately or to wait for subsidence of the acute symptoms.

Becker and others (1957) reported a 5·3 per cent surgical mortality if moribund cases were excluded. While Glenn (1957) has recently reported from the New York Hospital a series of operations in acute cholecystitis with a mortality of less than 1 per cent, he published in 1955 mortality rates of 2·12 per cent in patients aged 50–64, and 10·8 per cent in patients over this age. Pines and Rabinovitch (1954) reported

a large series from neighbouring Brooklyn with an overall mortality of 7 per cent.

From English sources, apart from Aird as quoted above, Oldham (1951), writing in *British Surgical Practice*, states that " the mortality rate of operations performed during the first day is not more than 5 per cent in the hands of expert surgeons, but operation later in the acute attack—especially on the third, fourth, and fifth days—carries a very high mortality ".

In some of these reports little or no attention is paid to the factor of age, which in our experience is of major importance in prognosis.

	Age Groups							
	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–100
Acute cholecystitis	2	16	29	46	56	57	42	18
Operation in close relation to acute cholecystitis	—	8	5	17	23	25	20	7
Routine cholecystectomy	2	15	39	46	49	35	12	1

Year after year, in a thousand or more cases of acute cholecystitis, we have observed that except in the aged, the capacity of intra-abdominal structures to wall off the inflamed gall-bladder is almost absolute, and that conservative treatment carries with it an insignificant mortality from abdominal causes.

Open perforation is almost limited to the elderly group, and it is only in them that early surgical intervention must be seriously considered as an emergency treatment.

Cholecystectomy during Acute Cholecystitis.—A second argument for cholecystectomy in acute cholecystitis is that since the patient with biliary tract disease has been forced into hospital this is a convenient time for operation. The writer has considerable sympathy with this viewpoint if it is limited to the practice of expert surgeons. It infers that if the indications for operation existed prior to the attack of acute cholecystitis, the surgeon will not be averse to operating during the attack, or soon after (for it must be realized that since the signs of pericholecystitis which constitute the attack subside long before the gall-bladder changes significantly from its acute stage, technical difficulties due to inflammation persist for a number of weeks).

If the patient on admission is dehydrated and starved, it is most unwise to proceed to an operation not specifically required for treatment of the attack. But these general conditions do not always pertain, or they may be corrected, and the decision as to operation then rests on the degree of increased technical difficulty to be expected in: (*a*) removing the gall-bladder, and (*b*) determining the normality of the duct system.

Each of these is difficult to determine preoperatively. Some inflamed gall-bladders are very easy to remove, while some are desperately difficult; on the average they offer more technical difficulties than when non-inflamed; and œdema around the cystic duct renders secure ligation of vessels and duct less certain. In nearly all cases the associated œdema in the gastro-hepatic omentum makes the state of the duct system more difficult to determine, and occasionally dissection in this thick, semi-organized swelling presents a real hazard.

In spite of all this, Glenn's figures, as also our own, suggest that cholecystectomy can be performed by the experienced surgeon in the presence of acute cholecystitis with little increased danger to life over that existing in the absence of inflammation, but with probably a considerable increase in morbidity and in late post-cholecystectomy symptoms.

There is no doubt that the convalescence of the great majority of these patients is remarkably smooth, and their pleasure at the early termination of the painful attack is very real.

Whether an acute cholecystitis predisposes to later troubles is a difficult matter to determine, and must not be decided on any theoretical basis. Though after such an attack many persons will have more gall-stones than they had before, this will not necessarily increase the incidence of biliary colic, which seems to depend on a single stone in a particular place.

The writer has a rather definite impression that an attack of acute cholecystitis is as much an incident in the life-history of gall-stones as a colic, and that in neither case can future events be prophesied.

Cholecystectomy after Acute Cholecystitis.—Though only 19 operations were performed during the course of acute cholecystitis, 86 were performed after the apparent subsidence of the attack, and of these 105 patients 5 died. This might seem to compare badly with 198 cholecystectomies performed in the absence of inflammation, with 1 death. To what extent did difficulties due to the persistence of inflammatory œdema account for this increased mortality?

It would appear that this was only a partial explanation. The average age at death of these patients was 73, and apart from the failure to save by operation a patient with bile peritonitis, the deaths were non-abdominal hazards of surgery in the aged, and are related mainly to the fact that this group contained relatively more old people than the routine cholecystectomy group.

This does not indicate that acute cholecystitis is a disease of later life, but rather represents the result of selection, since the group with recurrent colics tended to be picked from the Out-patient Department by the junior surgeons, and their choice seemed to be weighted towards younger and healthier persons; while the senior surgeons found the patients with acute cholecystitis in their wards, and managed them according to the surgical indications, or the patient's wishes. The only real lesson that emerges is the fundamental one that the risks of major surgery increase with age.

Of the 19 patients who were operated on shortly after admission, in 4 or 5 their advanced age or the extensive inflammatory signs dictated the necessity for emergency surgery; in the remainder surgery was carried out either as a policy for acute cholecystitis, or for the control of prior symptoms in the presence of acute cholecystitis.

Methods of Conservative Management.—Conservative treatment in our hands has few complexities. It is largely the management of symptoms, and consists of bed-rest and analgesics during the

stage of severe pain, abstention from food while nausea or vomiting is present, and occasional enemata. Intravenous fluids are rarely required.

Antibiotics, usually streptomycin and penicillin, are often given, but whether in these essentially chemical inflammations they exert other than a prophylactic effect is doubtful.

We believe that emergency surgery can be limited to severe attacks in feeble old people, when drainage of the gall-bladder may be life-saving, and

CERTIFIED DEATHS AFTER BILIARY TRACT OPERATIONS

Age Group	*Abdominal Causes*	*Other Causes*
20–29	1 acute liver failure 1 bile peritonitis	
30–39		
40–49	1 bile peritonitis	
50–59	1 bile peritonitis	2 pulmonary embolism 2 coronary occlusions
60–69	4 bile peritonitis 1 obstructive jaundice	2 pulmonary embolism 4 coronary occlusion 3 cerebral thrombosis 2 congestive cardiac failure 1 uræmia
70–79	1 bile peritonitis 1 stenosing cholangitis 1 liver failure	1 pulmonary embolism 2 senility and exhaustion 1 pneumonia
80–100		1 pulmonary embolus 1 congestive cardiac failure

in the rare cases in younger people where open perforation has occurred, or, because of the extent of the abdominal wall, inflammation seems probable.

This plan of management will result in more than 98 per cent recovery; and in comparison with routine emergency operation will save a large number of patients from needless surgery; and surgery, moreover, which if our indications for operation in gall-stones are accepted, will usually never become necessary.

These indications, as stated earlier, are that extent of recurrent painful attacks, whether biliary colic or acute cholecystitis, which in the opinion of the patient justifies the performance of a major operation for its control.

Biliary Tract Operations outside Surgical Centres.—Though it may be true that under optimal conditions results can be obtained from emergency surgery in acute cholecystitis comparable with those from conservative management, we believe that under present circumstances this former course could not be widely practised without a considerable increase in the mortality from biliary tract disease.

It is one thing to demonstrate the low mortality resulting from gall-bladder surgery in large city hospitals or in the hands of expert surgeons; but the general situation throughout a State presents no such bright picture. During 1956, 57 persons were certified as dying in Queensland from conditions associated with biliary tract disease, 35 of them after surgical operations, and the ages and causes of death of these 35 patients can be classified as shown in the table.

This is a very different picture to that presented at the Brisbane Hospital, where the youngest patient to die after operation was 65; and the proportion of abdominal complications, whether recognized or to some extent masked under the headings of coronary occlusion and pulmonary embolism, is disquieting.

If there was any widespread adoption of emergency operating in acute cholecystitis, addition of the results of this often technically difficult surgery might well produce a position far from flattering to the general medical profession.

SUMMARY

It has been shown that the application of conservative management to the vast majority of all cases of acute cholecystitis seen in Queensland results in a recovery rate of at least 98 per cent.

The predominant factors in prognosis are the age of the patient and the severity of the attack; and emergency surgery can be almost limited to the drainage of severe cases of the disease in very old people.

In the very large experience of the Brisbane Hospital staff, non-neoplastic biliary tract disease is a nuisance to its possessor rather than a serious threat to life, and there are good grounds for the belief that the presence of gall-stones does not alter significantly normal life expectation.

The surgery of the gall-bladder should be regarded as a therapy of pain rather than as a treatment for gall-stones.

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A TRIBUTE FROM AUSTRALIAN SURGEONS

By C. GORDON SHAW, Melbourne

In the winter of 1910–11 four recent graduates of the Melbourne Medical School, one of whom was the writer, arrived in London in search of knowledge and experience in the art and science of surgery. They entered the Middlesex Hospital and came under the professional tutelage of Gordon-Taylor, as he was then, a junior member of the staff of the hospital.

This was the beginning of an association between the Melbourne Medical School on the one hand and Middlesex Hospital and Gordon-Taylor on the other, which though cordial and fruitful at first, has become closer, stronger, and more valuable as the years passed. The personal friendship thus formed with Gordon-Taylor has ripened and has extended until it now embraces hundreds of surgeons who have visited London from this country, and who have been the recipients of his help and advice.

From 1911 there has been a steady stream of students from these shores to the Middlesex Hospital, where they found that Gordon-Taylor was ever ready to help them on their way with his wisdom and experience, his kindly advice and friendship, which were always given in such generous measure.

The members of the fellowship classes owe much to Gordon-Taylor for his instruction during those onerous times: his tutorials were indeed models of clarity and wide knowledge, the memory of which has not been obliterated by the passage of nearly fifty years.

Our next contact with Gordon-Taylor was in the first World War. During those grim years we saw a great deal of him in the Casualty Clearing Stations.

His untiring search after better methods of dealing with the wounded and the spirit of research which directed his efforts were a constant inspiration to all who came in contact with him, and the Australian Hospitals had a full measure of his help and experience.

Between the two wars and since the end of the second World War the flow of Australians to London grew to almost flood-like proportions. To all those who sought his help, and there were very many of these, Sir Gordon proved to be a wise guide and a helpful friend.

Sir Gordon's self-imposed task of placing surgeons after obtaining the fellowship in suitable surgical positions, though not spectacular, has been of the greatest value, and many Australians are indebted to him for this kindly service.

Sir Gordon has also paid several visits to this country.

He has brought to us much knowledge of the progress of Surgery, and also much of the history and tradition of British surgery, which with rich personal experience has been imparted to us with all the attractiveness of the polished lecturer. His visits to the hospitals, where he met all members of the staff from the senior consultant to the resident medical officer, will be remembered by all, and in these visits the ties of friendship formed in preceding years were renewed and strengthened. The operating surgeons who saw him at the operating table will never forget his interest and his helpful suggestions.

In order to show our appreciation of all that Sir Gordon did, St. Vincent's Hospital, Melbourne, asked him to accept the appointment to the Staff of Honorary Consultant Surgeon.

We feel honoured to have his name on the list of members of the Staff.

And in these latter years Sir Gordon is still working for those Australians who visit England. Many of them owe him a debt of gratitude for his interest in directing them in their studies and in obtaining for them surgical appointments.

His efforts are certainly untiring and for his continual efforts in this sphere we are sincerely grateful.

I feel that it is a privilege to be associated with this tribute to one who has done so much for Surgery and who has been such a good friend to so many Australian surgeons. The best that one can wish him is that he should continue to have great joy in the work which he has made so much his own, and in the gratitude and good fellowship of his many friends on both sides of the world.

ONE-STAGE TRANS-VESICAL PROSTATECTOMY

By JOHN POWER, Brisbane

Suprapubic prostatectomy is the old form of prostatectomy which has undergone many modifications over the years.

The operation which I propose to describe is based on the Harris operation as described in detail in the article in the British Journal of Surgery in 1934.

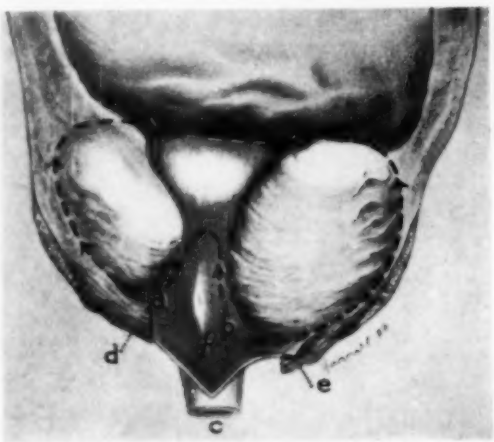


Fig. 617.—Drawing of post-mortem specimen of bladder and prostatic urethra, opened from the front, illustrating the intra-urethral method of enucleation of the prostate described in the text. The broken black line and the arrows thereon indicate the course followed by the finger during the enucleation. The points **a** and **b**, opposite the antero-inferior aspect of each lateral lobe, indicate the site at which the enucleation is begun on each side; **d** and **e**, The cut edges of the muscle of the anterior commissure; **c**, The membranous urethra; **f**, The verumontanum.

SELECTION OF PATIENTS

The most suitable patients for this operation are those where there is an obstructing mass of tissue at the bladder neck due to hyperplasia of the prostate.

Where the amount of prostatic tissue of this type is small, I believe they are better treated by trans-urethral resection. This also applies to mid-lobe obstruction, bladder-neck contractures, and median bars.

Calculous disease of the prostate where surgery is required is probably best dealt with by the retro-pubic approach.

The fitness of the patient for operation will depend on his general physical state, and more particularly upon his renal function and blood chemistry.

If the patient has not had any instrumentation prior to having been seen, urinary infection is not as a rule a problem. It is my considered opinion that the majority of patients with bladder-neck obstruction are fit for surgery with a minimum of pre-operative treatment. Harris, 23 years ago, advised at least 10 days' preliminary pre-operative catheter drainage or in some cases a preliminary cystostomy for 28 days. Only a minority of patients will require preliminary drainage and rarely cystostomy. Preliminary drainage is limited to those who show evidence of impaired renal function or grossly infected urine. Conditions other than urinary may also demand preliminary drainage.

PRE-OPERATIVE TREATMENT

Investigation of the patient is minimal. Routine culture and sensitivity tests of urine are done, and

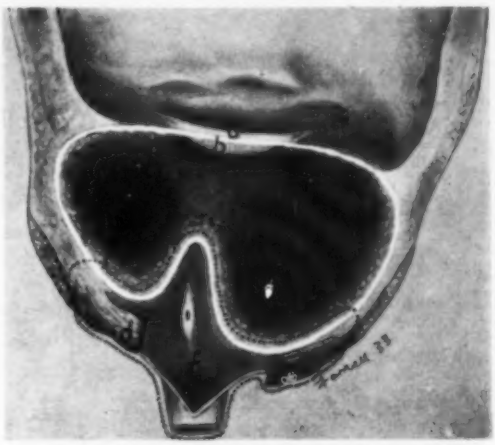


Fig. 618.—Same specimen as *Fig.* 617 after enucleation of the prostate. The heavy white lines outline the resulting cavity. It will be noted that the membranous urethra, the verumontanum, and the prostatic urethra around and distal to it have been left intact. The anterior commissure has been divided in this specimen for the purpose of exposing the interior of the prostatic urethra; during an actual operation it is left intact. The dotted black line surrounds the additional area which is commonly removed when the Freyer, particularly the open instrumental, method of prostatectomy is employed. **a**, The inter-ureteric bar; **b**, The trigonal muscle; **c**, The membranous urethra; **d** and **e**, The cut edges of the muscle of the anterior commissure; **f**, The verumontanum. (Semi-diagrammatic.)

where there is infection, suitable pre-operative treatment is ordered. Investigation of renal function is done by blood-urea estimations and intravenous urography.

I still find the indigo-carmine test a useful agent in the assessment of renal function. It is particularly useful for judging improvement in patients where renal efficiency is impaired at the beginning of investigation and treatment to improve it has been instituted.

With regard to the indigo-carmine test, Harris stated. "This is regarded as the final renal test of operability". I do not necessarily subscribe to this.

The presence of a large amount of residual urine is no indication in itself for preliminary drainage providing the patient's renal function is good and there is no sign of infection.

When practicable the patient arrives at the theatre with an empty bladder.

Pre-operative instrumentation or catheterization is not routinely practised. In some cases preliminary cystoscopy is done where the patient has had hæmaturia.

ANÆSTHESIA

I have a personal preference for mid-spinal anæsthesia given by an anæsthetic specialist, but

should there be any reason against spinal anæsthesia then combined anæsthesia is used.

OPERATIVE TECHNIQUE

The operative technique is based on the surgical principles so ably advanced by Harris in 1934.

These principles are :—

1. Intra-urethral enucleation as illustrated in *Figs.* 617, 618. This procedure is made easier by inserting two fingers of the left hand into the rectum.

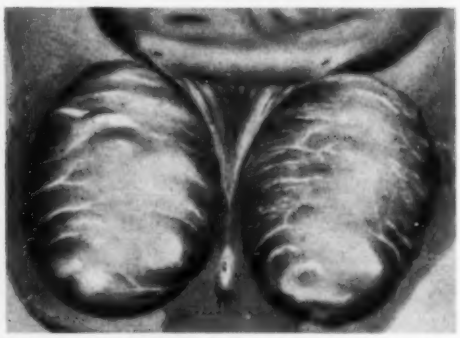


FIG. 619.—Drawing of post-mortem specimen of bladder and prostatic urethra opened from the front, and showing lateral lobe enlargement of the prostate with a perfectly normal posterior commissure.

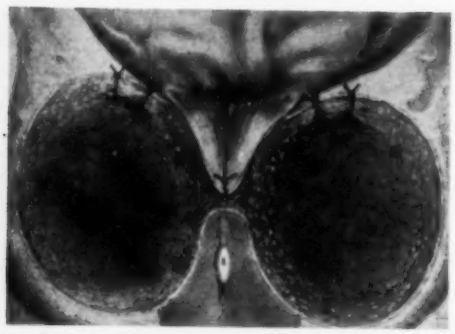


FIG. 621.—From the same specimen as *Figs.* 617, 618. The trigonal tongue is shown sutured in position as in the author's operation. (Pre-inserted here for ready comparison with the previous figure and to emphasize how closely reproduced is the normal anatomical relationship of the trigone and prostatic urethra.) (Semi-diagrammatic.)

Where there is no mid-lobe enlargement, the lateral lobes are removed as illustrated in *Figs.* 619, 620, the floor of the urethra being entirely preserved.

2. Rapid and easy control of hæmorrhage by the classical Harris hæmostatic sutures, as illustrated in *Fig.* 621.

3. Insertion of retrigonization suture.

In my opinion close approximation of the trigone and urethra (*see Fig.* 621), as described by Harris, is rarely achieved.

4. The anterior sutures 1, 2, 3, as illustrated in *Fig.* 622, to restore internal meatus to the size of one's little finger and to control any oozing that remains. These sutures are inserted after the catheter has been passed, usually using a 22 F. whistle-tip catheter.

These principles I believe to be essential for the successful application of the operation. At this stage there should be no active bleeding.

At this point I diverge very widely from the classical Harris operation.

Until seventeen years ago, I always performed the primary closure of the bladder as described by Harris, but since 1940 I have always used suprapubic drainage for 48 hours after operation, occasionally longer. Nursing problems became acute and necessitated my doing this in the early war years. I found that a closed system of irrigation can then be employed. I believe this solves the nursing problem

FIG. 620.—Same case as *Fig.* 619 after removal of the lateral lobes. The trigone has remained undisturbed in its normal position. Two hæmostatic sutures are shown on each side. (Semi-diagrammatic.)

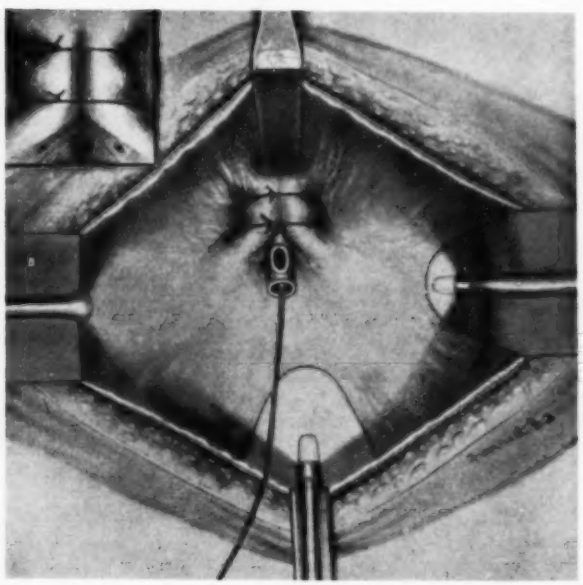


FIG. 622.—Second transverse obliterative suture inserted : plastic operation completed : catheter with silkworm-gut transfixion suture in position. The catheter is passed intact and the tip cut off after a second eye has been made.

Inset : Same stage before passage of the catheter. Note that there is no visible raw surface, that the trigonal flap lies on a plane below that of the rest of the bladder base and is firmly bedded in position, and that the lateral edges of the prostatic rim are deeply inverted, thus partly re-forming the side walls of the new prostatic urethra.

in these patients and limits the risk of contamination, and does not prolong the period of post-operative urethral drainage. This procedure was originally used by Mr. Stanley Roe. The patient should be fit for discharge from hospital in 14–18 days, except where complications arise.

Antibiotic treatment is based on pre- and post-operative sensitivity tests.

Post-operatively the patient is kept under observation and treatment where possible until urinary infection is no longer a problem.

MORTALITY RATES

No figures available, but only an occasional death has occurred.

COMPLICATIONS

1. **Embolic.**

2. **Renal Failure.**—Has been a very rare complication with the single-stage operation.

3. **Hæmorrhage.**—Primary and reactionary hæmorrhage are rare. In most forms of prostatic surgery we still have an occasional secondary hæmorrhage.

4. **Infections.**—I have been rarely bothered with persisting urinary infection since the introduction of antibiotics.

5. **Epididymitis.**—In spite of the occasional occurrence of this complication I do not practise vas ligation.

6. **Post-operative Obstruction.**—I have had no personal experience of post-operative obstruction at the bladder neck with this operation. Like most urologists, I find urethral stricture follows transurethral resection more frequently.

7. **Osteitis Pubis.**—This appears to have been a very worrying complication after the retropubic operation, but has only occurred once in my twenty-eight years of urology, and therefore is very rare after transvesical prostatectomy.

In conclusion, I think this operation has a very definite place in prostatic surgery. It is comparatively easy to execute, gives a high degree of comfort to the patient afterwards, and has few complications and a low mortality rate.

To be invited to contribute an article to the special birthday number of the BRITISH JOURNAL OF SURGERY to mark the eightieth birthday of my friend Sir Gordon Gordon-Taylor is an honour I deeply appreciate.

SURGERY OF BASAL-CELL CARCINOMA

BY B. K. RANK, C.M.G., AND A. R. WAKEFIELD, MELBOURNE, AUSTRALIA

IN Australia, basal-cell carcinoma of the skin is of special and peculiar interest. Its aetiology is full of paradox. Though there is some weight to the general thesis, that this country provides a climate and an environment for which Northern European skins have not been conditioned (Molesworth, 1927), it is clear that the widespread incidence of this skin carcinoma cannot be reduced to any such clear-cut explanation. Southern European immigrants are by no means immune from its development. Admittedly more common in the hotter and drier regions and among outdoor *habitués*, it is certainly not confined to particular occupational groups as the terms 'mariner's disease' of early British writing or 'cancer de cultivateurs' of the French might suggest. So, too, there are surprising exceptions to its more common age incidence.

The very extensive medical literature on this subject from all countries in the post-war years covers much clinical and pathological discourse, but there is a scarcity of well-documented information on the efficacy of treatment. Such reports as do appear almost entirely concern the results of radiotherapy, which are expressed in general terms of a recurrence rate within an arbitrary period of three or five years—figures which are poorly documented and which are commonly quoted from one paper to another. Professor B. W. Windeyer, in a Hunterian Lecture, February, 1951, merely stated without substantiation that "it is possible to cure by radiation 95 per cent of rodent ulcers if they are free from bone or cartilage", and he developed the commonly copied thesis that choice of treatment depends on "functional and cosmetic results". Some expression from Australian surgeons on this subject is perhaps long overdue.

As patients with this disease are so often treated as out-patients, and as it is but rarely lethal, all massed statistics derived by means used for other forms of malignant disease are of necessity incomplete and, in general, so worthless that some anti-cancer organizations have ceased to collect and dissect them.

At the turn of the century, when relatively little was understood of the varied nature and behaviour of skin carcinoma, surgery had earned a bad reputation in the treatment of this condition, which commonly presented in an advanced stage—"*Noli me tangere*". It was natural therefore that as radiotherapy was first widely introduced about this time it would have its most obvious and regular place in such conditions. Ever since then it has generally been regarded as the method of choice for treating skin carcinoma, surgery being relegated to a secondary place—more particularly for cases where radiotherapy has already proved ineffective.

In British writings the only strong recent plea for surgery as the method of choice in treating basal-cell carcinoma has been that of Wakeley and Childs in the *British Medical Journal* (1949). Their paper raised some heated correspondence, in answer to which they set out the only figures we have been able to find concerning results of surgery in recent years. In America, Gordon New (1949), of the Mayo Clinic, among others, has been a consistent advocate of surgery for this carcinoma.

In the past fifty years not only have the techniques of surgery and radiotherapy improved, but much has been learnt of the pathology and behaviour of skin malignancy. It is therefore timely for some critical and dispassionate review of this condition and the problems it raises. Not only is it a matter first and foremost of doing what is best for patients, or of

cold scientific interest, but it is a matter which fundamentally concerns huge expenditures in setting up modern clinics and institutions—their equipment, staffing, and maintenance. We have no wish to raise a fishwives' argument between the vested interests of surgeon, dermatologist, or radiotherapist, but we do wish to set out the results of what we believe is a rather peculiar experience for the sober consideration of those interested in this subject.

Table I.—Review of Cases of Epidermoid Carcinoma treated by Surgery over Ten Years, December 1945–December 1955

Comparing results (as at December, 1956) in cases previously untreated (Group A) with those in cases recurring after previous treatment (Group B)

Epithelioma-cell Type	Squamous*		Basi-squamous (Mixed)		Basal	
Group	*A*	*B*	*A*	*B*	*A*	*B*
No recurrence in 1 yr.	5	2			20	24
2 yrs.	14	3	2	2	44	31
3 yrs.	13	4	4	2	36	20
4 yrs.	3	1		1	30	12
5 yrs.	1	2		1	7	13
6 yrs.	2	4		1	17	12
7 yrs.	3	4	1	1	9	6
8 yrs.	1	1	1		5	10
9 yrs.		3		1	3	6
10 yrs.	1				13	9
Died without recurrence within :— 1 yr.					3‡	4
2 yrs.	1				6	2
3 yrs.	3	1			6	1
4 yrs.	1				2	2
5 yrs.			1		3	1
6 yrs.	1	1			1	
7 yrs.	1					
8 yrs.						
9 yrs.						
10 yrs.						
Recurrence noted in :—† 1st yr.	4 (3)	6 (3)		2 (1)		6
2nd yr.				1	1	5
3rd yr.	1 (1)	2 (2)		1	1	7
4th yr.						4
5th yr.						2
6th yr.						1
7th yr.						
8th yr.						
9th yr.					1	
10th yr.						
Cases not traced	2			1	9	5
	57	34	9	14	217	183

Total—514 (in 425 patients).

Notes

* Does not include lesions of the lip.

† Includes 3 cases found to be inoperable at time of operation. Figures in parentheses represent the cases which ultimately died from the disease.

‡ One case died of cerebral hæmorrhage a few hours after operation—the only operative mortality.

As surgeons specializing in reparative surgery in a country where the occurrence of skin carcinoma is commonplace, we have had opportunity in the past ten years for some clinical and pathological study of basal-cell carcinoma and for its surgical management under present-day conditions. We are in no doubt whatever that the careful application of modern reparative surgery and modern prosthesis places a new complexion on the place of ablative surgery for skin cancer—especially where the face is involved. We have also learnt that this is no place for irresponsible claims—there being certain limits to the application of surgery for this disease. The final conclusion of Wakeley and Childs (1949) recommending surgical excision of "*all* rodent ulcers" is unfortunate and certainly needs some qualification.

This paper is based on a recently completed review of all cases of skin carcinoma which we have treated by operation during a ten-year period ending 1955. It is perhaps the first detailed and extensive personal follow-up study of surgery in the treatment of basal-cell carcinoma under present-day conditions of earlier diagnosis and the more rational excision which a more complete understanding of pathology indicates and which modern reparative surgery permits.

In common with most surgeons in this field of work, we see a large number of cases in the group commonly presented for surgery after radiotherapy has failed to control or eradicate the disease. For this reason, and also because of the many cases demonstrating the varied complications of radiotherapy, it might be said that our attitude must be biased and that we see only a special minority group of poor results, or the results of badly applied or misused radiotherapy—for there must be all grades of radiotherapists as there are all grades of surgeons. This criticism might be justified were it not for the fact that in an endeavour to clarify rising doubts about the commonly accepted place of radiotherapy, we have taken the opportunity of conducting a clinical trial of surgery as the method of election in primary treatment of basal-cell carcinoma. It was hoped to gain some perspective alongside common claims and to determine whether there is any real need for the difficult recurrences and complications we are so often called on to treat after primary treatment by irradiation.

Table I sets out the interim results during 1956 of all cases of proven skin carcinoma operated on in our units at three hospitals over a ten-year period up to December, 1955. A total of 514 lesions from 425 patients are embraced in the figures set out.* This paper is confined entirely to the consideration of basal-cell carcinomas (our figures for pure squamous-cell lesions over the same period are included only for completeness, realizing that they are of little comparative value, as squamous-cell lesions with their attendant problems of gland field metastasis are more often managed as a general surgical problem).

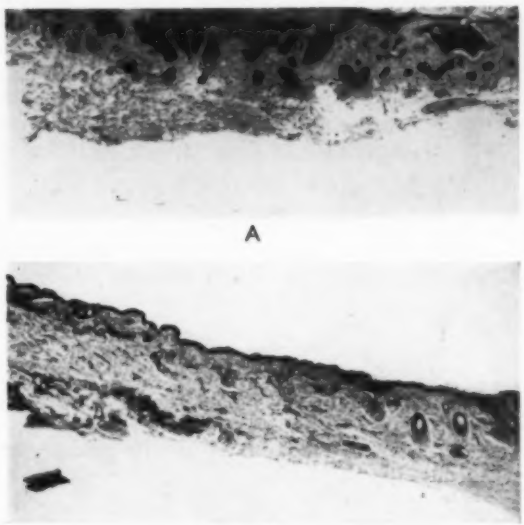
Group A. Lesions which had not been subjected to Previous Treatment.—This group is of special interest. There is no doubt that most of the cases submitted to operation would have been successfully treated by radiotherapy, but during this period we have only referred to the radiotherapist those cases where a patient refused surgery, or where

* These figures include only those cases for which we were able to check the pathology. Six cases were discarded because specimens were lost—also 38 cases for various errors in previous diagnosis (15 of these were cases of molluscum sebaceum and most of the others we considered were innocent lesions).

the condition was regarded as inoperable for reasons to be elaborated later.

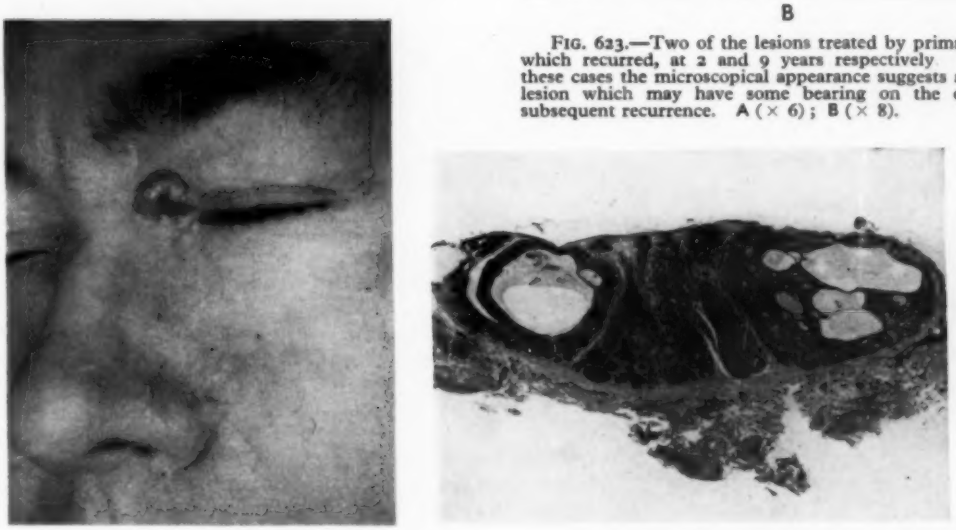
In general it can be stated that in ten years—of the 226 cases in this category subjected to operation—there have to date been only 3 recurrences. One case which manifested recurrence after three years was an advanced lesion in the lower eyelid region attached to bone and involving the maxillary antrum, a lesion which was doubtfully curable. Another case manifested recurrence at the edge of a graft on the temple area nine years after excision, and though it was probably a new lesion we could not be sure of that, so it is included as a recurrence. The third case manifested recurrence after one year. *Fig.* 623 shows the histological appearance of these two latter lesions and it will be seen that they are of a diffuse and multifocal nature, which may have some bearing on the fact of recurrence.

Group B. Lesions which had been subjected to Previous Treatment (i.e., recurrent or persistent lesions).—These present quite a different story. Of 197 lesions all but one had received previous radiotherapy. In this group we have to date had 29 recurrences, i.e., 15 per cent. Many of these cases



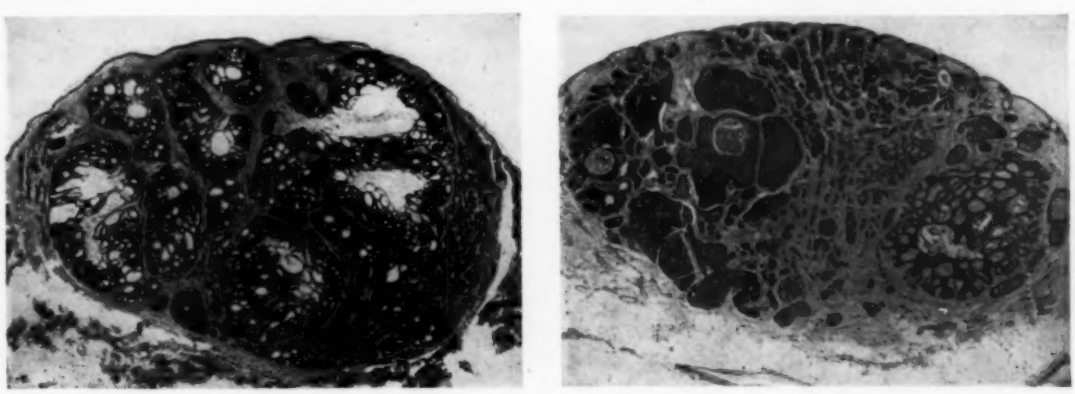
A B

FIG. 623.—Two of the lesions treated by primary excision which recurred, at 2 and 9 years respectively. In each of these cases the microscopical appearance suggests a multifocal lesion which may have some bearing on the question of subsequent recurrence. A (× 6); B (× 8).



A B

FIG. 624.—A, A typical cystic basal-cell carcinoma in a common situation (history of eight years). These lesions are well eradicated by excision and a free whole skin-graft as in *Fig.* 632. B, Microscopical picture of this lesion which illustrates the confined nature of the disease. (× 6.)



A B

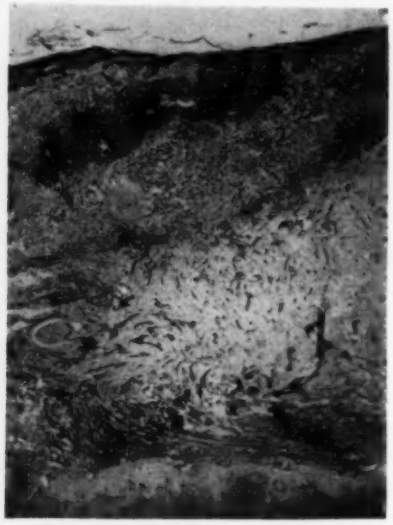
FIG. 625.—Typical localized cystic types of basal-cell carcinoma. The natural history of these lesions is quite a different story to that of the infiltrating type of basal-cell carcinoma as seen in *Fig.* 626. A (× 10); B (× 12).

have been subjected to further surgery—a few to radiotherapy. Though the majority have not since recurred a second time, some have.

It is on the comparative experience of these two groups of cases, without proceeding to detailed analysis of all the figures elaborated, that certain deductions on more contentious matters, which may run contrary to commonly accepted teaching and practice, are discussed below.

PATHOLOGY IN RELATION TO PROGNOSIS

In this review it soon became obvious how histological structure has some relation to the wide variations in the clinical picture and behaviour



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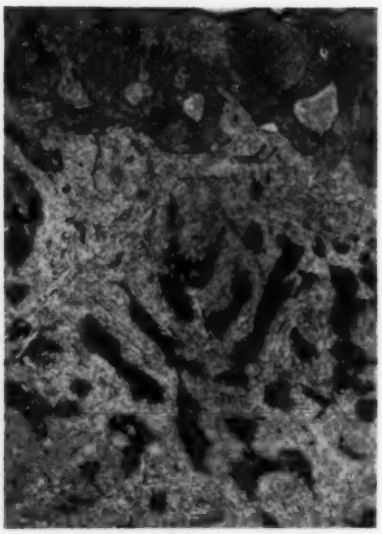


C

of basal-cell carcinoma. This, of course, is well appreciated in the general pattern of malignant disease, but in the case of basal-cell carcinoma it has not perhaps generally influenced prognosis and management to the degree that it should. It is well known in the case of squamous-cell epithelioma that a low-grade, well-differentiated lesion, as seen on the back of the hand in the elderly for example, is remote in its behaviour from an anaplastic rapidly proliferating and metastasizing growth in a young person. With the far more common group of basal-cell epithelioma, however, it is not so generally realized that the pattern of structure and behaviour varies to an even greater extent. Some writers have elaborated on this (Teloh, 1953; Thackeray, 1951). Though the precise histogenesis of these growths is still speculative, some of the histological variants of basal-cell carcinoma, e.g., sebaceous, sudoriferous, or adenocystic structure, have been regarded as indices of differentiation and of less malignant behaviour, analogous to the more differentiated squamous-cell lesions. Our study

B

FIG. 626.—Typical infiltrating types of basal-cell carcinoma. A, Shows infiltrating cords of basal cells extending wide and deep from the main focus. (× 24.) B, High power of same. (× 57.) C, Another example of the same type of growth.

would substantiate that thesis* so far as clinical behaviour is concerned and it seems obvious that statistics or comparisons of methods of treatment can only be misleading if they are not dissected at least in relation to the two most clear-cut histological variants of basal-cell lesions, i.e., the compact localized lesion and the diffuse infiltrating lesion. For example, the common so-called cystic type of basal-cell lesion (*see Figs.* 624, 625) is a lesion so compact, so localized, and so slowly proliferating that its nature might well be doubted as a malignant disease at all. It is an easily recognizable clinical entity, and its natural behaviour is such that a close but clear removal can be regarded as finite. There can be no valid reason whatever for any form of treatment for it, the result of which is subject to trial or doubt, or which is open to any grade of secondary complication. Many of the cystic lesions occur about the nasocanthal region. They do not call for the more drastic excision that a less massive but

* In 34 cystic basal-cell lesions and 20 adnexal-type lesions there has been no single recurrence either in Group A or Group B cases.

uncontained infiltrating basal-cell carcinoma warrants. It might be considered that all lesions which ultimately become diffuse and infiltrating start as a compact local lesion. However, the study of a large number of small lesions which had a short history does not indicate this—they differ widely in their smallest and earliest stages and in untreated lesions

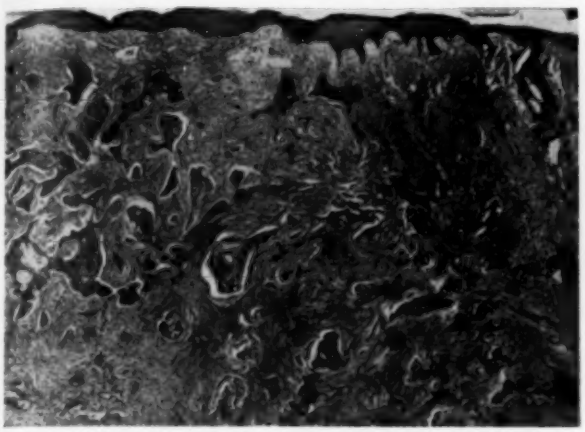


FIG. 627.—A typical mixed—basi-squamous—type of lesion showing features of both basal and squamous-cell lesions. (× 15.)

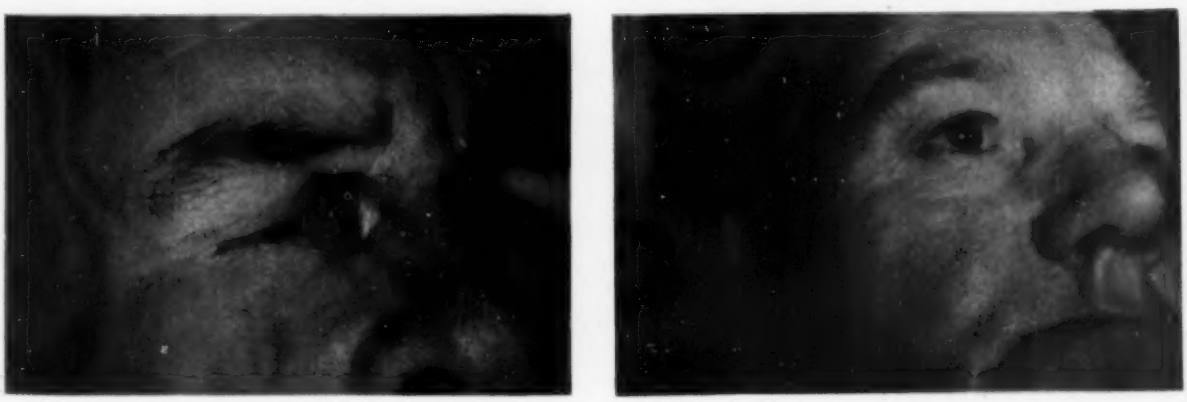
the different characteristics of appearance and behaviour seem to persist. In ' recurrent ' lesions, however, it must be noted that the more differentiated features are rarely seen—most of them show the long infiltrating strands of basal cells—though the clinical history clearly suggests that some of these were probably more differentiated at an earlier stage before treatment.

In the case of the uncircumscribed infiltrating type of basal-cell carcinoma (*Fig.* 626), low grade and benign as the cell picture might appear, the natural history of slow penetration along tissue planes and bony or cartilaginous surfaces is such that methods used for its eradication cannot be assessed in the usual arbitrary terms of a three-year or five-year recurrence rate. Some criteria other than those commonly used to express results of malignant disease should be applied to these skin lesions. The very word ' recurrence ' gives a wrong interpretation of the clinical manifestation of failed treatment. Incomplete eradication would be a better interpretation in the large majority of cases. We do know that some lesions are multifocal in origin (as was suggested in 12 per cent of the basal-cell lesions we studied) and some arise in areas prone to malignant degeneration for a common reason, e.g., radiation dermatitis—in which cases a so-called ' recurrence ' may well be a new lesion. Nevertheless, these conditions should not cloud the fact that in a large majority of cases ' recurrence ' is an expression of failed treatment.

It is of some interest that of three cases who ultimately died because of uncontrolled extensive and destructive spread of basal-cell carcinoma, despite manifold treatments—all had been ' cured ' more than once in their early history. But while doctor and patient had buried their heads in the sands of apparent cure, the remaining basal-cell strands had been burrowing far and wide. Thus when in such cases a ' recurrence ' is ultimately manifest, its extent may be very difficult to assess and it is usually under-estimated as a basis for inadequate secondary treatment in a long and tragic story.

Mixed (Basi-squamous) Lesions.—The group of skin carcinomas showing mixed features of basal-cell and squamous-cell lesions deserves some comment. Writers have shown varied interests in these lesions. It is clear that what one pathologist calls a mixed or basi-squamous lesion, another does not consider as such. The occurrence of a few prickle cells or an odd cell nest is not uncommon in many basal-cell lesions, and does not warrant a diagnosis of a ' mixed ' or basi-squamous lesion. We have only included in the ' mixed ' group lesions where the cell picture and arrangement was truly mixed and indeterminate (*see Fig.* 627). On this basis we have classified only 23 mixed lesions amongst the group of 514 skin carcinomas.

We would substantiate the observations of others that mixed-cell lesions are more common in lesions previously treated by radiotherapy, and there was a number of examples where classical basal-cell lesions have subsequently become mixed-cell lesions or typical squamous-cell carcinoma. It is this fact



A B

FIG. 628.—Common sites for problem ' recurrences '. A, A lesion of the inner canthus infiltrating far down the medial wall of the orbit, which renders this case inoperable. B, A lesion starting at the alar base which has extended back into the nasal vestibule despite varied forms of radiotherapy over eight years. Excision included the posterior segment of the alæ nasi and a block of tissue including cheek, upper lip, nasal floor, and underlying bone. The defect was covered with split skin-graft and reconstruction deferred for a period of at least one year's observation.

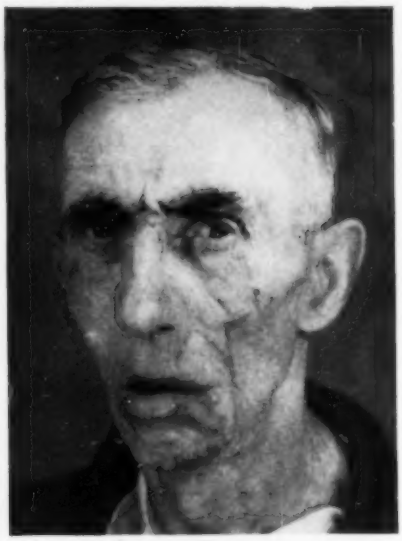
which explains why some apparently basal-cell lesions have metastasized to glands. We have, however, had one clear-cut case (reported elsewhere —Rank, 1958) of a typical basal-cell carcinoma metastasizing to glands as a pure basal-cell lesion.

PREVIOUS TREATMENT IN RELATION TO PROGNOSIS

It may be stating the obvious to say that a lesion which recurs or remains after some form of primary treatment presents added problems of management.

A

C



B

FIG. 629.—Illustrates the ease and effect of local flaps for repairing excision defects in the common cancer age group. A, A basal-cell carcinoma of the upper lip. B, One week after excision and primary repair by local transposition flap which is outlined. C, Two months later.

These confront both surgeon and radiotherapist irrespective of the method of treatment which has been used initially. Apart from any inadequacies in the application of primary treatment, and apart, too, from an accepted proportion of lesions which prove resistant to radiotherapy, this recurrent group includes lesions the extent of which has already been misjudged by ordinary working clinical criteria. Whatever the factors or clinical errors conducive to failure a first time, they are even more likely to cause failure a second time. The number of second recurrences among our group of previously treated cases is significant (15 per cent) and commonly quoted observations concerning this group of cases warrant some criticism.

1. The teaching that recurrence after radiotherapy is generally best treated by surgical excision is subject to much misinterpretation, for the common working inference is to apply this to all recurrent cases. Windeyer (1951) writes that " recurrences should be treated by surgery even if it means an extensive procedure ". Such unqualified statements often lead surgeons to operate on inoperable lesions and many patients are made the worse for this. It is often thought that if a case recurs after surgery or if it is not suitable for surgery then it must be right for radiotherapy, and conversely if a case recurs after radiotherapy or is not suitable for irradiation, then it is best treated by surgery. This may be so, but frequently it is not so, and where recurrent disease is concerned it may be nearer the truth that cases unsuited to one form of treatment are equally unsuited to the other, and often for the very same reasons. Recurrent lesions should be subjected to surgery if, and only if, the oft-forgotten criteria of operability can be satisfied, i.e., if the anatomical site and extent of the lesion are such that a planned excision elaborated on clinical estimates can be carried out in all its extent and dimensions with reasonable guarantee of success. With recurrent lesions, especially those slow to become manifest or in areas such as the inner canthal region or the base of the ala nasi where deep-plane extension is likely (*Fig.* 628), infiltration has probably been going on for a long time and often extends far from the site of apparent recurrence.

Adequately planned excision of such recurrent lesions may involve a wide and destructive operative procedure, anything short of which only leaves the patient worse off than would the natural behaviour

of the uncontrolled lesion. Spread of these growths may be very slow and reaction to them often has much effect in containing the lesion for a very long period. The fibrosis resulting from radiotherapy may have the same long-containing effect. If we seem sceptical in believing that many so-called cures not operated on at all, for we have seen fit to modify our earlier views of operability in these cases.

2. The dictum that a patient with advanced disease should be given his only chance by operation, despite ordinary clinical judgements, can also be

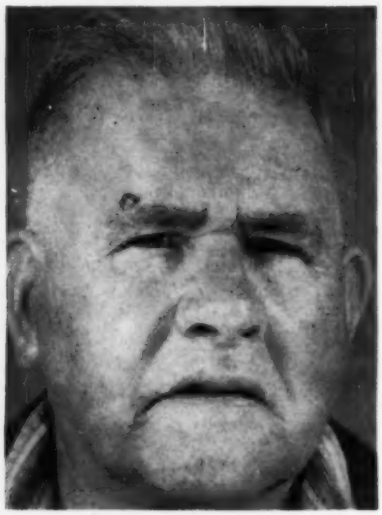
FIG. 630.—Illustrates the use of large rotation advancement flaps for repair of defects after excising lesions of the cheek. These cases illustrate the excellent results of facial repair in this age group. A, Shows a diffuse lesion on the cheek of eight years' duration. B, The result one year after wide excision and repair by a rotation advancement flap from the posterior cheek and upper neck. C, D, Illustrate another case before, and four years after, a similar type of operation, in this case done under local anæsthetic.

are just that, we can find justification not only in our histological studies, but in some unhappy results following marginal excision of irradiated regions preparatory to elective secondary repair after supposed cure.

Our results in Group B after secondary surgery for recurrent cases after radiotherapy are not very impressive and are in no way comparable with the results in Group A of primary surgery. In retrospect there are perhaps cases in this Group B which, if managed in more recent years, would have been submitted to a far more radical operation or else overworked. Radiotherapy may have some place in the palliative treatment of basal-cell carcinoma, but surgery has none. It may be argued that there are no limits to destructive surgery for the fearless surgeon—but when facial destruction is concerned there are humanitarian considerations and patients have some rights. There are no rules on these matters so intimately linked with the age, intellect, social status, outlook, and worldly objectives of every individual. Patients should be given a proper explanation of the order of the destructive procedure anticipated, the likelihood of cure, and the possibility

of realistic repair or camouflage of the resulting defect.

3. It is again often argued that even if some lesions prove recalcitrant with radiation treatment, this matters little because surgery can then always be used as a second line of defence. Windeyer develops this line of thought (1951). The relatively



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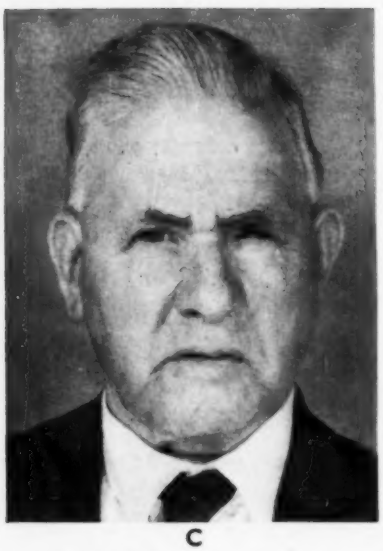

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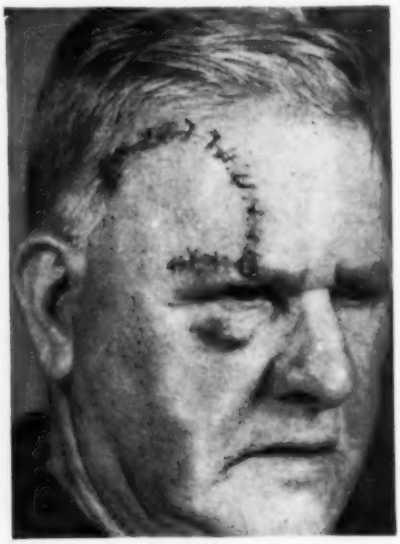

B

FIG. 631.—Illustrates a common application of a classical rotation advancement flap (Estlander). A, A pigmented basal-cell carcinoma in the eyebrow region. B, One week after excision and closure by an Estlander flap. Some sutures have just been removed. C, The appearance six months later.

poor results of secondary treatment by surgery again surely have some bearing on this viewpoint. For young people especially, primary treatment should be that which offers the best prospect of cure. For a lesion which we know is only locally malignant and which presents in an early and manageable stage, any recurrence should be considered an indictment of clinical judgement or technical procedure. If it is generally agreed to submit recurrent or recalcitrant lesions for surgery, why not forestall this most unhappy group of cases? They cannot be written down as some acceptable minority figure, for recurrence rate in terms of a mere number by no means expresses the quantum of morbidity in individual cases, which is often very great indeed. Figures do not give the picture in true perspective. Included in this minority figure are so many people who in good faith have presented for treatment in the early and curable phase of a disease, which so rarely kills, and yet they must pay an unfair and unnecessary price in lifelong misery and morbidity.

4. If, therefore, it can be shown that surgery offers some important advantages as well as *a more uniform prospect of cure* in this common form of skin malignancy it is not unreasonable to reconsider some of the claims which have been made over the years in favour of radiotherapy.

Apart altogether from the basic question of the rate of cure, there are two side-issues which have not only been used in a rationalizing way, but have been taken up as a catchcry by the profession, and by the public at large. Even if they were valid they should be relegated to a very secondary place in selecting primary treatment.

a. Relative Cosmetic Results.—As plastic surgeons dealing with disfigurement of all grades and types in people with diverse expectations we can presume some authority under this heading. It is easy to make very unreal comparisons. Generalizations cannot be made; it is only reasonable to attempt comparison relating to similar lesions in similar situations in similar patients. So far as small lesions are concerned, a well-healed surgical incision directed with knowledge, imagination, and care, especially in the age-groups more concerned (*see Figs.* 629–635), is certainly no more disfiguring than the degree of skin atrophy following radiotherapy. Granted, this may be minimal. Granted, too, there are occasional complications of operation with scar formation as the result of secondary healing, and keloid may result even with primary healing. With careful attention to details of aftercare the former is uncommon, and is corrigible, and we see little of keloid from well-planned incision lines in the middle and upper

age-group people. Over all, for comparable lesions the residual disfigurements after surgery compare more than favourably with the results following radiotherapy. It seems that the latter are very variable, and the degrees of skin atrophy or scarring are analogous with the end-results of burns. If there has been deep partial skin damage an atrophic bleached patch of skin devoid of normal skin function, and usually bared of hair growth, results, comparable with the end-result of a deep second-degree thermal burn. If there has been complete skin destruction, healing by secondary intention leaves a depressed scar, like that after a third-degree burn. Again as with burns many so-called radiation 'reactions' are complicated by infection which adds considerably to epithelial damage and protracted healing. Infection about and beneath the crusts of a dye-coagulant is a common observation. Still more massive deep tissue necrosis only differs from a deep thermal burn in its slower, more painful, and more protracted course. However, so far as more extensive lesions are concerned the argument concerning disfigurement has no place at all except where irreparable and gross mutilation is contemplated—cure is the primary concern. When gross destructive processes are involved a post-radiation defect has generally to be converted to a surgical defect before effective reconstruction or camouflage can be undertaken.

FIG. 632.—Illustrating repair by free skin-grafts after excision of eyelid lesions. A, Basal-cell carcinoma of the lower lid of three years' duration. B, C, Illustrate the end-result three years after primary excision and split skin-graft to the defect. This operation was done by our house surgeon, Dr. McLeish. D, Shows another basal-cell carcinoma in the same region persisting after radiotherapy. E, Shows the result one year after wide excision of the recurrent lesion and a full-thickness (Wolfe) skin-graft to the defect.

b. Expediency and Economy of Treatment.—This, too, is a secondary consideration. Where elderly people are concerned, especially where there are multiple lesions and when expectation of life is measured, many of these cases should perhaps remain in the hands of the radiotherapist. This, however,

should be tempered by the observation that operation risks* in this type of case are nowadays negligible and local anæsthesia is very effective in face lesions (*Figs.* 629, 630). Multiple attendances for elderly patients over a protracted period of irradiation treatment can mean much nuisance and expense, sometimes with long-drawn-out discomfort and painful reaction. The average hospital stay after primary ultimate effects. Easy availability has been built up on past conceptions and is now used as an argument of expediency in choice of treatment. It is our obligation as doctors to assert that organization be geared to demand rather than passively to accept the converse. Relative costs to the community would not stand up to comparative examination. The cost of setting up and maintaining an ordinary

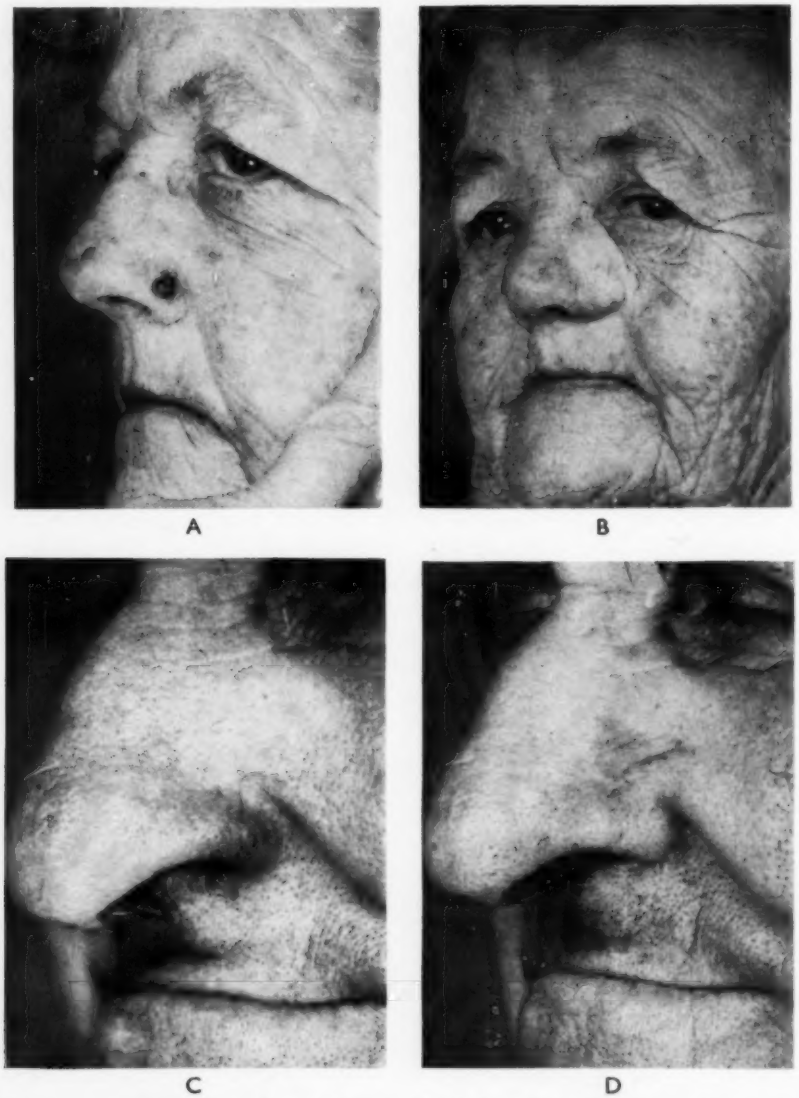

FIG. 633.—Illustrates common methods of repair after excising lesions of the alar base region. A, A typical basal-cell carcinoma attached to the alar cartilage (1 year's history). B, Two years after excision of the alar base and repair by a transposition flap from the cheek based upwards. The secondary defect on the cheek has been closed by direct suture. C, A lesion in similar situation (2 years' history). D, The result four months after excision of skin and cartilage and local flap repair. In this case a flap from the lateral nasal groove based downwards was used and the secondary defect on the nose closed by a post-auricular Wolfe graft.

surgery for these cases is less than a week. This is a more convenient proposition, especially for country patients, when it is compared with the drawn-out arrangements for multiple daily treatments, waiting and observation of reaction, its treatment, and its operating room service is little compared to the capital expense and maintenance of an efficient, modern radiotherapy service and the ancillaries which it demands.

5. Secondary Complications of Treatment.—Though difficult to express in terms of figures, it is well known in the day-to-day work of any plastic surgeon that the secondary complications of surgical operations have nothing to compare with the host

* One of the cases in this case series died of cerebral hæmorrhage a few hours after operation—the only operation mortality among 425 patients, many of whom had multiple operations.

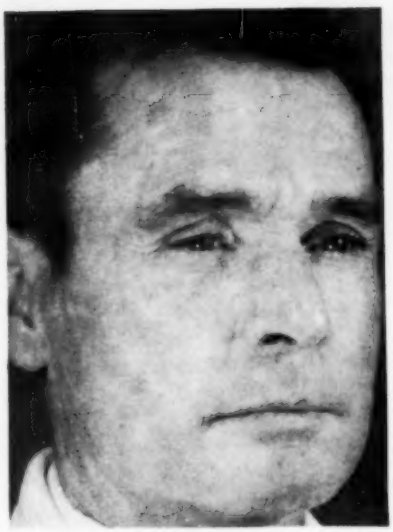

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FIG. 634.—Illustrating methods frequently used for repairing excision defects in the region of the inner canthus or base of the nose. A, B, Show the result after primary excision of a basal-cell carcinoma near the inner canthus and repair by a whole skin-graft from the post-auricular area. In B the grafted area is outlined in ink. C, D, E, Illustrate a common method of forehead flap repair necessitated by the excision of a recurrent lesion to bare bone. C, Shows the recurrent lesion; D, The condition after detachment of the forehead flap (second stage); E, Two months later. Time will add considerably to the further resolution of residual scarred areas.

of residual troubles attributable to radiotherapy. It is appreciated that there is good and bad radiotherapy and that radiotherapists themselves have done much to minimize the complications of their agents. Nevertheless, they still occur. Therapists order, for wide error by the time the treatment order is interpreted and carried out by someone else on a patient who is quite incapable of remaining absolutely motionless over a period involving many subdivisions of a total dosage. It is hardly surprising therefore

FIG. 635.—Illustrates a typical course of management for a recurrent lesion infiltrating deep structures on the nose. A, Recurrence after radiotherapy. There is little to see on the surface but widespread infiltration among nasal cartilages. B, After partial nasectomy and primary closure of skin to mucous membrane. C, The patient is fitted with a camouflage prosthesis during a period of one year's observation. D, Nasal reconstruction by forehead rhinoplasty (two-stage) is under way. E, F, The end-result five years later, i.e., six years after partial nasectomy for a recurrent lesion.

but rarely conduct, treatment and there are many personal factors. Margins of error must be multiplied by the number of persons involved between the ordering and the carrying out of treatment. The ordering and carrying out of treatment is curiously unscientific in a speciality that poses as a fairly exact science. The radiotherapist, who, armed with a ruler and a set of tables, orders treatment calculated to produce a certain intensity of dosage at a depth estimated to within a millimetre cannot seriously believe that the patient gets anything closer than a rough approximation to this. There is room that underdosage and overdosage are commonplace, and there is no need to go further than this for an explanation of why, in spite of an ever improving background of theory to help with the selection of both the estimated dosage and the method of delivering it, failure of the estimated response on the one hand and tissue necrosis on the other is still common. Techniques are still far from ideal, and it is small consolation to individual patients with recurrence or necrosis to know that each has contributed to an average which should be theoretically correct.

OBLIGATIONS OF SURGEONS IN TREATING SKIN CANCER

Though it is our purpose to advocate an extended application of surgery as the prime method of treatment in skin cancer, we are emphatic that this must be executed only with the highest sense of responsibility by individuals practised in clinical assessment of cutaneous malignancy, fully aware of its pathology and behaviour, and skilled in the application of modern reparative surgical techniques. This may be asking much, but anything less is prone to lead to a breaking up of responsibilities in diagnosis and management, which can only once again bring disrepute to the surgery of this condition. We would go so far as to say that advocating surgery is conditioned by the availability of surgeons who possess all these qualifications. We are in frank disagreement with Wakeley and Childs (1949), who state that " in almost all cases rodent ulcers may be treated in the out-patient department under local anæsthesia ". In our experience nothing is more conducive to poor results and, if this were to be accepted practice, the primary treatment of basal-cell carcinoma as we see it would be far more effective in the hands of the skilled radiotherapist.

The technical details of surgery in its application to skin carcinoma in particular regions is not within the ambit of this paper, but the principles can be set out as follows :—

1. If the Criteria of Operability cannot be satisfied, Surgery is contra-indicated (*Figs.* 628, 636).—

a. The site, size, and stage of progress and nature of the lesion must be such that it can be clearly excised in every dimension. It must be emphasized that this is a clinical estimation, made pre-operatively by one individual, the surgeon, who considers, plans, and executes his operation accordingly. There is only one personal factor. If there are no underlying tissue-plane barriers, depth excision should be even wider than marginal limits of the tissue block, and where lesions are close to tissue-plane barriers, such as periosteum, perichondrium, or deep-fascial planes, these should be removed beneath the lesion.

b. The patient's general condition and expectation of life must be such that the procedure is reasonable when weighed against the risks involved and the alternative methods of treatment available. It may be in the patient's best interest to abstain from treatment of any sort.

c. The patient should understand and be agreeable within reason to the order of procedure involved after any necessary ablation of essential structures such as nerves, eyelids, or lacrimal system has been explained to him. Likely disfigurements, and the possibility of their repair or camouflage, should also be explained. Operability may mean the sacrifice of an eye and there are obvious implications in such decisions.

2. Detailed Pathological Examination of the Block by a Pathologist is Obligatory.—There are many methods of organizing this so that sections cut are indicated by the surgeon and it is our practice in larger lesions to remove marginal specimens from key areas after the planned removal has been executed. Thus the pathologist, with whom the surgeon should work in closest collaboration, is of help in a much more significant way than by merely establishing the histological nature of a lesion from some small biopsy specimen. By systematic examination of the lesion in relation to excision margins and neighbouring structures, he can make very pertinent observations about the confines and extent of the lesion and the adequacy of removal, in relation to its nature. As mutual understanding is built up this becomes a most reliable guide to effective surgery. It is an opportunity for controlled treatment denied the radiotherapist. We have frequently followed up excisions with immediate re-excisions if the histological examination suggested that a removal was inadequate. This is not the least of the special advantages of surgery.

FIG. 636.—An inoperable lesion. A recurrent basal-cell carcinoma with a history of 15 years in a man of 79. There is widespread infiltration among deep structures. Operation was undertaken because of intense pain, but local recurrence was obvious within two months and the symptoms were not alleviated.

3. If Ablative Surgery of the Lesion is selected it must be carried out without regard to the Salvation of Particular Structures and without Compromise in relation to the Problems of closing any Resultant Defect.—In practice this means that there is a further consideration than that of operability. The criteria of operability, elaborated from clinical examination, are absolute and make a decision which cannot be varied in its application to a particular patient. This poses the second question : Is the planned excision reasonable and justified ? Can it be reconciled with retention of important and essential structures, considerations of repair, or camouflage ? This second decision is not absolute and does vary from one patient to another. It must not affect the cold anatomical consideration of operability, though it may raise contra-indications to operation in particular patients. Regions which raise problems, and where mistakes are frequently made, are the inner halves of the eyelids where efforts to save a lacrimal canaliculus are sometimes responsible for recurrence and spread of a lesion back into the inner wall of the orbit. There must be no compromise. We cannot agree with Professor

Windeyer (1951) where he says: "Small lesions at the medial end of the lower eyelid and which are not involving the punctum should be treated by surgical excision if they can be removed with adequate margin without damaging the structure." A watery eye may be a handicap, but a recurrent lesion in this locality is a tragedy. Experience shows that in this

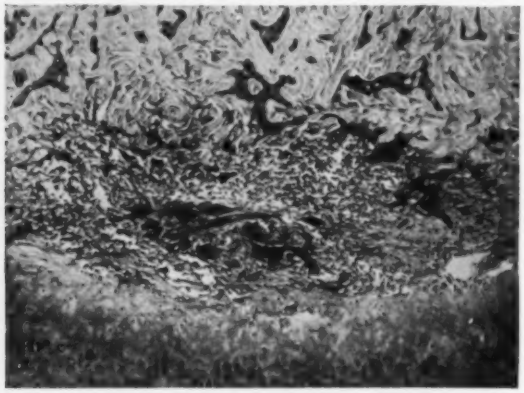


FIG. 637.—A typical microscopical picture of a lesion infiltrating down to the cartilage barrier. Infiltration occurs widely along such a plane long before there is any infiltration of underlying cartilage and bone. Adequate excision of such lesions, however, requires removal of such understructures.

region there is generally but one opportunity of cure —the first treatment.

Regions where there is a good bulk of soft tissue such as on the cheek, lesions satisfactory for radiotherapy no doubt, likewise are most suited to surgery, for depth excision can be as clear as the peripheral margins. There are many regions on the face, however, where a cutaneous lesion does not have to spread very deeply before it is on to bone, cartilage, or mucous lining, e.g., the nose, the ears, the eyelids. There, again, mistakes are frequently made by the superficial removal of the soft tissues from such structures. It is a good working rule in such situations to excise in a tissue plane deeper than the natural barrier of spread. It is clear from histological studies that fascial planes, periosteum, and perichondrium do withstand basal-cell penetration for a long time (*Fig.* 637). On the other hand, once infiltration gets to these natural barriers it can spread peripherally very far and wide. We have seen deep and wide extensions in the orbit and within the cranial cavity from eyelid lesions which show relatively little on the surface. Another notorious area is at the base of the ala nasi, where deep extension can soon get back along the lateral nasal wall or spread around the outer surface of the maxilla in a most surprising manner. Barret-Brown's aphorism that "nothing burrows like the basal cell" is sound.

4. Reparative Surgery.—In relation to excision of skin carcinoma, there is every scope for application of known plastic surgery procedures (*see Figs.* 629–635). But, apart from technical procedures used to achieve immediate healing, there is need for judgement in the nature and timing of reconstructive procedures, especially in relation to extensive or recurrent disease. The many permutations of procedures and methods which are called for are set out diagrammatically on the facing page.

Two aspects of this problem present in every case: (*a*) Should the defect be reconstructed, and when? (*b*) Can the defect be reconstructed, and how?

a. Nothing in surgery is more disastrous than reconstructive surgery in the region of, or covering over, residual malignant disease. When in these circumstances recurrence or failure becomes obvious the boats are burnt, for the whole area is now suspect and the condition often inoperable. Those who advocate changing surgeons at this important juncture between destruction and construction do not tell us who makes this vital decision. It can only be made, and the responsibility for it maintained, by one surgeon.

Virgin, untreated superficial lesions on facial areas which do not involve bone or deep tissue planes, and the nature of which we know, are no worry. We are quite happy to do a primary finite repair operation in such cases and are little concerned about the size or site of the lesion. It is a very different matter in the case of recurrent disease in irradiated areas, or where disease involves skeletal structures, or if the extent of disease is indeterminate. In these circumstances we should reject all primary reparative procedures which involve shifting of local tissues or covering the region with any tissue bulk. Primary closure is achieved in these cases by suturing skin to mucosa about the margin of excised defects or by split skin-grafts as temporary dressings (*see Figs.* 635, 638)—avoiding as far as possible the moving of local flaps. This is not just an arbitrary arrangement, but something learnt time and again by all plastic surgeons. The more elaborate the reconstruction indicated, the more liberal we must be in our 'wait and see' policy, and we should think in terms of not less than twelve months. If then a cure is considered likely from the nature of the disease, its extent, and the trial of time, we must offer the alternatives to the patient with a proper explanation of pros and cons. Does he wish to stay as he is?; is he happy to continue with his prosthesis?—some are and some are not; and does he realize the implications of surgical repair? Moreover, does he understand the order of result he can reasonably expect? The indications of youth and middle age are quite different from those of the elderly. Life expectation, social status, and many personal considerations again arise—and there is every call for reason.

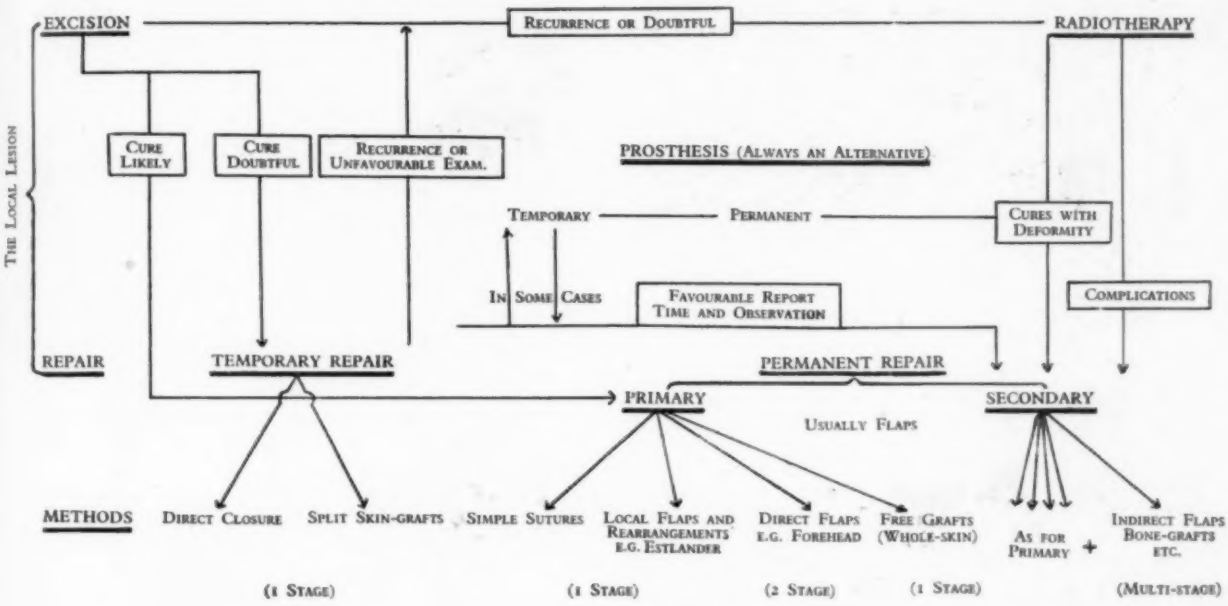
b. Can the defect be repaired? In the cancer age group, we can effect repairs of a very high standard so far as skin cover, lining surface, soft tissue, or bone bulk are concerned. Middle-aged and elderly patients scar well—there are generally redundant surface tissues, and they have outgrown keloid tendencies. When, however, we come to replace muscular and mobile structures there are some strict limitations. It is true that we often appear to be able to make mobile structures. This is because muscle loss or denervation is often incomplete, or because the filling in of a defect in a circular muscle mass, around the eye or mouth for example, may give some effective function. The destruction of wartime injuries, gross as they might appear, was seldom as complete as that of a radical surgical excision or of massive radionecrosis. This limitation concerning mobile structures sets two problems with which we are frequently presented.

i. *The upper eyelid*: Total reconstruction of an upper eyelid still maintaining the functioning integrity of an eye is very difficult. A mass apron-like structure can be made over an artificial eye which behind the camouflage of heavy horn-rimmed spectacles may pass. To be presented with a total upper lid defect as a *fait accompli* in the presence of an exposed eye may present an impossible situation, when patients are full of expectancy because they have been misled—'We will refer you to the plastic surgeons to have new eyelids made'. It is no help to say 'something must be done'. The question is, What?—for we can make conditions worse.

ii. *Mass amputations of the lower face* present a similar problem. Amputations of jaw, chin, cheek, and lower lip may be done for infiltrating malignant disease. Similar ultimate defects may follow slow destruction after radiotherapy with the added disadvantage of avascular, fibrosed, and eczematous surrounds. Having spent untold man-hours and patience on reconstructions of such defects, we come to the view that many of them should be regarded as irreparable. If patients knew this it might well have a totally different bearing on original treatment or advice. We can migrate large soft-tissue masses to make something which at fifty yards distance in a football crowd would not raise comment and we can restore bone continuity, but we cannot make mobile structures with normal sensation. We only provide at best a dead-weight, uncontrollable mass of tissue which gets covered with spittle and bears excoriation badly. It is not suggested that the initial treatment was necessarily wrong in these cases—it may well have been the right treatment. We only wish to make the point that these patients who have got quite enough to put up with should not be subjected to moral let-down or breach of faith. There is no place for treatment at all costs. Many patients, we are sure, would be better to finish life with their disease—all of us have to die of something and the natural compensations in the symptomatology of untreated malignant disease are full of surprises.

Moreover, of these unfortunate people who after a long history of failed treatment are submitted to ultra-radical mutilating operations, how many are cured? In our experience very, very few, and at what cost? . . .

iii. *What of camouflage prosthesis?* Improvement in materials and methods for making camouflage



prosthesis combined with some appreciation of artistry have perhaps not been generally exploited as much as they should be (*Fig.* 638). In filling in the present-day deficiencies of plastic surgery, more especially in relation to cancer patients, notable improvements have been made in this direction (Rank, 1957). Furthermore, certain operative procedures can be directed to the better wearing and fitting of these aids. Prosthesis following radical surgery concerns a group of cases to which most radiotherapists lay no claim, i.e., cases of such extent that therapy can only be palliative or painfully destructive.

It should be noted, however, that there is a wide divergence between the satisfaction of fitting a camouflage to a well-prepared and healed area so that junction lines can be made at natural lines or points easy to camouflage, and being asked to fit a prosthesis over some hopeless hole, unhealed and discharging, surrounded by bone necrosis, where the indications are for surgical dressings. It is unreasonable to expend time and expense in camouflaging a defect the shape and size of which will be quite different from week to week as long as healing is incomplete and granulation and contracture continue. Furthermore, even with prosthesis, there are technical limits to the replacement of mobile structures, not in the case of the orbital region, for this is generally where camouflage prosthesis is best, provided there is no eye remaining to be protected. but certainly in the case of the upper lip. With

few exceptions most cases in this category, and fortunately there are few, all come back to some arrangement they work out to their own satisfaction with dressing, plastic tape, or brown elastic adhesive. Sometimes a light plastic shield can be provided to give some contour to a dressing.

In short, the ultimate prospects of repair and prosthesis must be taken into account *ab initio* in selecting the optimum treatment for particular cases, and the camouflage prosthetist who can combine artistry with knowledge of modern prosthetic materials and their processing is invaluable to the organization which handles this type of case.

A

B

C

D

CONCLUSION

It is obvious that there is opportunity for close-knit team-work involving individuals skilled in various fields, but let us be clear about our conception of team-work. Let us deplore a train of separate individuals covering various stages of management one after another, none of whom has any real conception of what condition preceded the stage when his interest was sought, nor knows much of subsequent events. It is impossible to learn anything about the treatment of skin cancer if patients are not seen through to finality, successful or otherwise. A disconnected succession of individual specialists is often held up as team-work, and present-day organization in the management of cancer fails badly wherever this state of affairs exists.

There is an unfortunate tendency in many centres for the surgeon to be excluded from his rightful place in this organization. Wherever surgery has been regarded as a secondary line in the treatment of basal-cell carcinoma it has become common practice for these cases to be treated by individual dermatologists and radiologists, with a show of results they regard as highly satisfactory, but which perhaps under more critical scrutiny are not good enough. Surgeons are called in only to treat failures and complications and advanced cases considered unsuitable for therapy (which in many cases are also inoperable). On this practice and teaching arguments have been so built up that not only do practitioners refer all their skin cancers for radiotherapy but the public is misled by the catchcry

'that they can be easily cured nowadays without the knife'.

Having seen so much of the results and complications of this fixed line of thought we believe that to-day there is urgent call to modify such ideas. It is not for us to state the scope and place for radiotherapy, but to submit that the claims of present-day surgery are such that the line of first consultation should at least include a surgeon. He has the right *general hospitals* from which patients should only be drafted to specialized institutions and clinics as is then and there decided between all their representatives, whose combined experience is nowadays something quite beyond the scope of individuals.

Acknowledgements.—We are pleased to record our gratitude to Dr. J. D. Hicks, Pathologist to the Royal Melbourne Hospital, who has given much

E F

FIG. 638.—Illustrating the place and value of modern camouflage prosthesis for temporary or continued use after ablative cancer surgery. A, After partial nasectomy for recurrent basal-cell carcinoma of nasal tip region. B, Shows use of temporary camouflage prosthesis which this patient has elected to continue indefinitely. C, After complete nasectomy. Closure was completed by split skin-graft about the lower reaches of the defect. D, Camouflage prosthesis which was used for one year. This patient elected to proceed with forehead rhinoplasty. E, After excision of lids and eventration of orbital contents for an infiltrating basal-cell lesion. F, Wearing a permanent camouflage prosthesis.

at least to a controlled trial of surgery in open competition with the radiotherapist. This could well bring quite a new emphasis to organizations that are being developed the world over. When so much money is being spent on the fight against cancer, much of it against hopeless odds, it is unreasonable not to pursue an improved outlook among some of the more common lesions which can be cured and where there is obviously room for improvement. It is suggested that the practitioner who short-circuits surgical opinion in his reference of these cases, and the institution that purports to treat cancer and at the same time fails to provide facilities for surgical consultation and treatment on a par with those provided for other lines of treatment, are both failing gravely in their obligations to provide their patients with the best chance of cure of their disease.

Carcinoma of the skin is a disease which in Australia warrants far more attention and critical examination than it has received in the past. The case is a strong one for consultation clinics *in the*

time and patience in studying with us the histological material which forms the main basis of this study.

Mr. Roy Ingles, also of the Royal Melbourne Hospital, is responsible for most of the illustrations. Many kind people have been involved in helping with a difficult follow-up pursuit, chief among them being Miss Barke and Miss Adey of the Royal Melbourne Hospital, Miss McCall of The Anti-Cancer Council and Records Staff of the Repatriation Department.

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THE SURGERY OF CARCINOMA OF THE HYPOPHARYNX

By STEPHEN SUGGIT, Brisbane

Hypopharynx is used in the wide sense and includes the pyriform fossa. The 11 cases described below form a small series compared with much of the published work, but cover a period of eleven years and illustrate many of the problems encountered in this field. Three of the cases (*Cases* 2–4) were shown, shortly after the plastic repair was completed, at the laryngological section of the Royal Society of Medicine (Suggit, 1948).

Fig. 639.—*Case* 2. Tumour removed at operation, including the superior pole of the right lobe of the thyroid gland, through which a biopsy section has been made.

CASE REPORTS

Case 1.—A woman, aged 39, was admitted to University College Hospital, London, complaining of soreness of the throat and difficulty in swallowing solids for three months. No abnormality was seen on indirect laryngoscopy, and no glands were felt. Direct endoscopy showed the upper edge of a carcinomatous ulcer just below the arytenoid area. The section showed squamous carcinoma grade 2. The lateral radiograph of the neck showed gross narrowing of the hypopharynx from C.6 to T.1 vertebræ.

Feb. 27, 1946: After preliminary tracheotomy, through a right lateral pharyngotomy, a complete segment of the pharyngo-œsophagus together with the right lobe of the thyroid gland and the lymphatic tissues was excised. The internal jugular vein was not removed on the right side. The hypopharynx separated easily from the posterior surface of the cricoid cartilage. The pharynx and œsophagus were sutured into the skin incision as two separate stomata. Considerable excoriation of the skin around the œsophageal stoma resulted from regurgitation of gastric juice. This was eventually controlled by buffer gel *p*H 8. No gastrostomy was done and she was fed by a tube into the œsophageal stoma. Local recurrence in the post-cricoid area was first noted on Nov. 13, nine months after excision, and before skin-tube junction between the pharynx and œsophagus had been achieved. She died on April 1, 1947, fourteen months after excision of the tumour. Autopsy showed a carcinomatous gland on the lesser curvature of the stomach, in addition to local recurrence.

Case 2.—A woman, aged 62, was admitted to University College Hospital, London, with progressive dysphagia for two years, and had swallowed only fluids for two weeks. She had lost 2 st. in weight. A swelling of the neck was palpable, accentuated by the thinness of

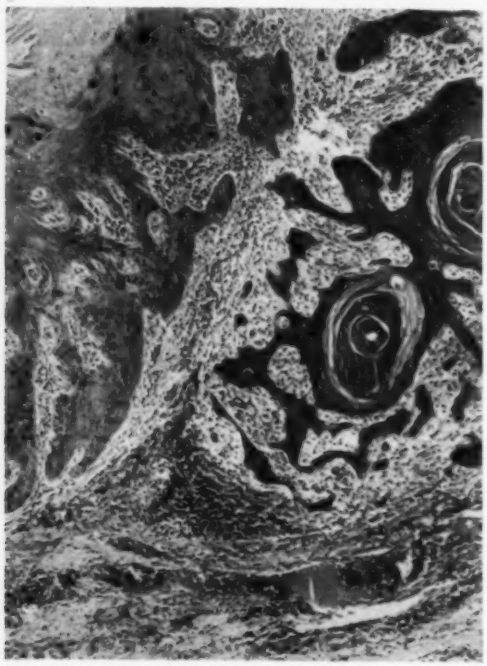

Fig. 640.—*Case* 2. Section showing a well-differentiated squamous carcinoma. (× 52.)

Fig. 641.—*Case* 2. X-ray picture of the neck, showing the segment of skin-tube (marked with arrows) joining the pharynx and œsophagus.

the cervical muscles. X-ray films showed constriction of the hypopharynx down to the thoracic inlet, and a swelling of the posterior pharyngeal wall. On indirect laryngoscopy the upper edge of the carcinoma on the posterior wall of the pharynx was seen, surrounded by a pool of saliva. A preliminary gastrostomy was done under local anæsthetic on April 18, 1946, and a direct laryngoscopy and biopsy on May 1.

FIG. 642.—*Case* 3. Specimen of tumour removed at operation. A piece has been removed for microscopy at the left posterior angle.

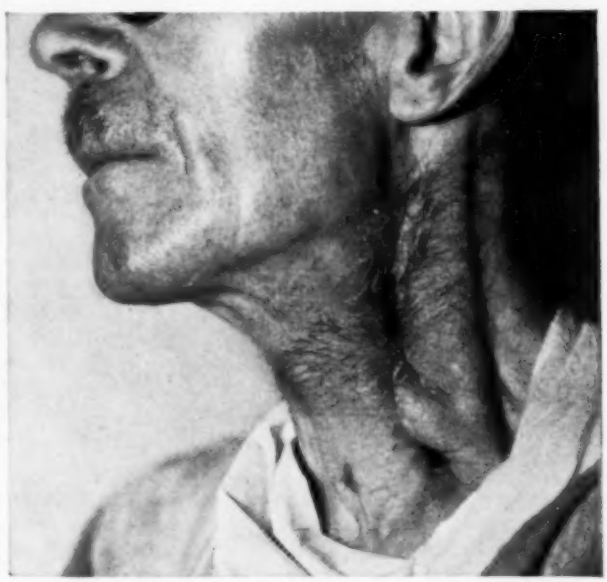

FIG. 644.—*Case* 3. The pharynx and œsophagus end blindly on the surface of the neck, the mucosa having united with the margins of the skin-flaps at each of the two openings.

Left lateral pharyngotomy on May 10, *preliminary tracheotomy*.

Some large glands were removed from the region of the bifurcation of the left common carotid artery. The internal jugular vein was spared. The left side of the thyroid was excised. The specimen removed consisted of a complete segment of the pharyngo-œsophagus with part of the right lobe of the thyroid gland, into the superior pole of which the carcinoma had begun to infiltrate (*Fig.* 639). The skin was sutured, enclosing the opening of the œsophagus in the lower part of the incision and the opening of the pharynx in the upper part, skin being sutured to the mucosal edge at each stoma.

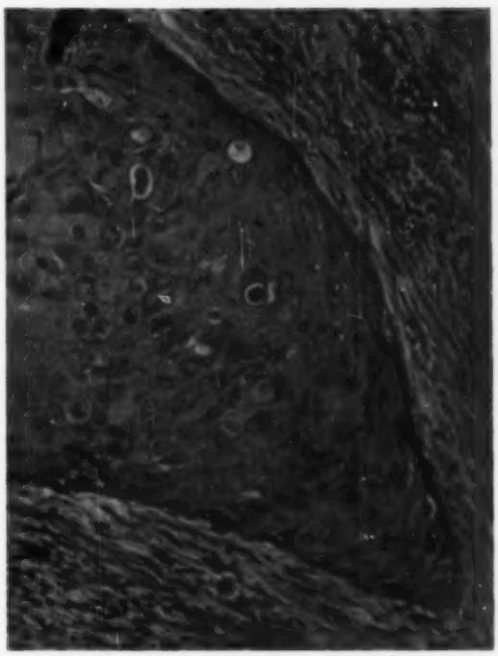

FIG. 643.—*Case* 3. Section showing grade 1 squamous carcinoma. (× 144.)

FIG. 645.—*Case* 3. Thoraco-acromial tube pedicle. The œsophageal stoma can be seen just below the edge of the bandage.

The section showed squamous carcinoma, grade 1 (*Fig.* 640), but the glands were clear. On May 29, I dissected up a tube pedicle, smaller and higher in position

than the customary thoraco-acromial pedicle. A skin-tube junction between œsophagus and pharynx and repair of the neck was completed in two stages by July 10 (*Fig.* 641). Swallowing by mouth was begun on July 20 and the gastrostomy was abandoned by the end of August. By March, 1947, she had gained 2 st. in weight. She died suddenly in May, 1948, the radiograph showing bronchopneumonia, but she lived in the country and no autopsy was done. She had been well, and showed no evidence of recurrence, during the two years between excision of the carcinoma and the bronchopneumonia.

Case 3.—A man, aged 71 years, was admitted to University College Hospital, London, complaining of pain and difficulty in swallowing for two months. The upper edge of a malignant ulcer was seen on indirect laryngoscopy on the left posterolateral wall of the pharynx, and X-ray films showed a constriction in the

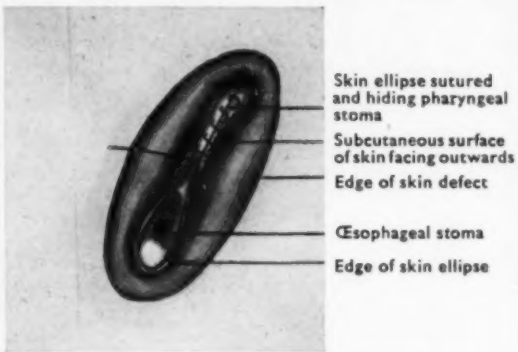
Continual suture
Skin ellipse sutured and hiding pharyngeal stoma
Subcutaneous surface of skin facing outwards
Edge of skin defect
Œsophageal stoma
Edge of skin ellipse

FIG. 646.—*Case* 3. The ellipse of skin surrounding the pharyngeal and œsophageal stomata is being invaginated along its long axis by a continuous catgut suture. Completion of this suture line forms a skin-tube uniting the two stomata. The upper pharyngeal stoma is already hidden inside the tube; the lower œsophageal stoma is still visible.

hypopharynx extending down to the thoracic inlet. Direct pharyngoscopy and biopsy had been done at another hospital. A preliminary gastrostomy was done on Sept. 5, 1946, by Mr. D. N. Matthews, who subsequently assisted me in removing the tumour, and directed the subsequent repair operations. On Sept. 20 after preliminary tracheotomy, using a left lateral pharyngotomy exposure, the tumour was removed. To get adequate clearance it was necessary to remove a complete segment of pharyngo-œsophagus, but there was no difficulty in preserving the larynx. The tumour is shown in *Fig.* 642. The probable site of origin was the lateral pharyngeal wall at the caudal end of the pyriform fossa. The section showed a grade 1 squamous carcinoma (*Fig.* 643).

Oct. 9: Acromiothoracic pedicle fashioned, and an epilation dose of X rays applied to the cervical skin.

Nov. 20: On the upper posterior part of the pharyngeal stoma at the mucocutaneous junction a small nodule was noticed. This was removed. Section showed some large necrotic cells. Professor G. R. Cameron considered these were carcinoma cells, but not viable. In view of this, contact X rays were given to the stoma margin, 1000 r repeated three times over a period of six days.

Jan. 10, 1947: A skin-tube junction between the pharyngeal and œsophageal stomata was formed from the ellipse of cervical skin enclosing those two stomata under local anæsthesia. The area of neck, thus exposed, was covered by implanting the medial end of the thoraco-acrominal tube pedicle into the raw area and suturing to the skin margins (*Figs.* 645–647).

Jan. 21: Swallowing by mouth was begun.

Jan. 31: Excess skin pedicle flap removed.

Feb. 25: Gastrostomy tube left out.

Patient discharged from hospital March 1.

In September, 1947, I removed some hair from the skin implant to the pharyngeal wall by direct laryngoscopy. The growth of hair was profuse. He remained well until October, 1954, when he was admitted complaining of frequency of micturition every quarter of an hour day and night. A suprapubic prostatectomy was done by

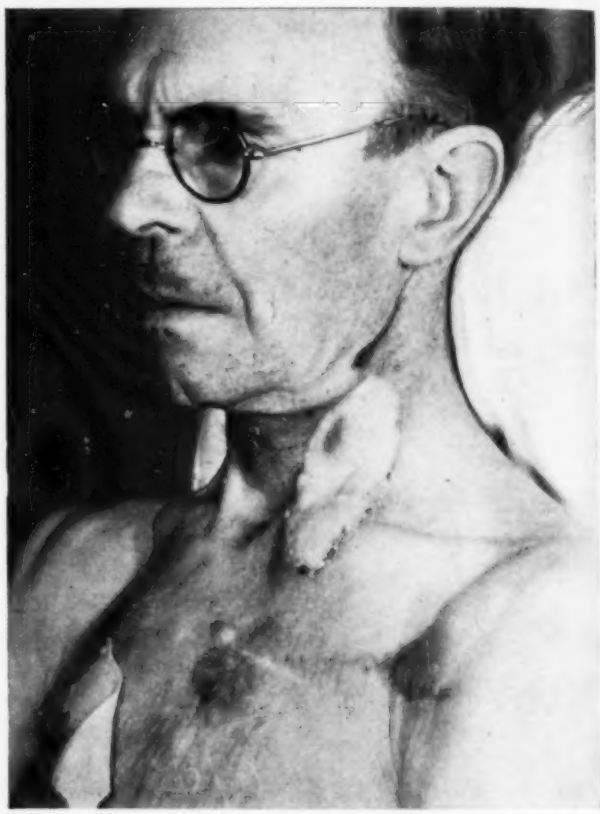

FIG. 647.—*Case* 3. The completed plastic. The part of the neck covering derived from the tube pedicle is clearly visible. The redundant pedicle has been removed.

Mr. D. N. Matthews, who had collaborated with me eight years before, but the patient died of a coronary occlusion four hours later. An autopsy was done, but there was no evidence of malignancy.

Case 4.—A woman, aged 46, was admitted to the London Chest Hospital complaining of difficulty in swallowing, both solids and fluids, for three months. She was wasted and looked ill. A large cauliflower growth on the posterior pharyngeal wall was seen on indirect laryngoscopy.

Jan. 24, 1947: I did a biopsy and extracted a number of foul teeth. The section showed squamous carcinoma with cell nests (*Fig.* 648). No preliminary gastrostomy was done.

Feb. 7: *Left lateral pharyngotomy.*

Following tracheotomy, the fatty tissue and fascia were stripped up from the great vessels on the left side of the neck but the internal jugular vein was spared. The ala of the thyroid cartilage, the left lobe of the thyroid gland, and the left cornu of the hyoid bone were excised. The growth was extensive and the whole segment of the hypopharynx and upper œsophagus was removed (*Fig.* 649). The pharynx and œsophagus were sutured to the skin-flap margins so as to form two separate stomata.

A gastrostomy was done on Feb. 21 as the feeding tube was irritating the cervical skin. The thoraco-cervical tube pedicle, completion of the skin-tube junction between the pharyngeal stump and the œsophagus, and

the final trimming were done in three stages under local anæsthetic on March 4, April 14, and May 5 respectively.

Swallowing, however, was never satisfactory though barium passed down into the œsophagus. Oct. 17: Direct examination showed inflammatory stenosis at the junction of the skin-tube and œsophagus, and three days later I reopened the neck, using a flap, and resutured the skin-tube œsophagus junction over a large-bore rubber tube, anchored by a thread through the skin. The tube was removed endoscopically four weeks later.

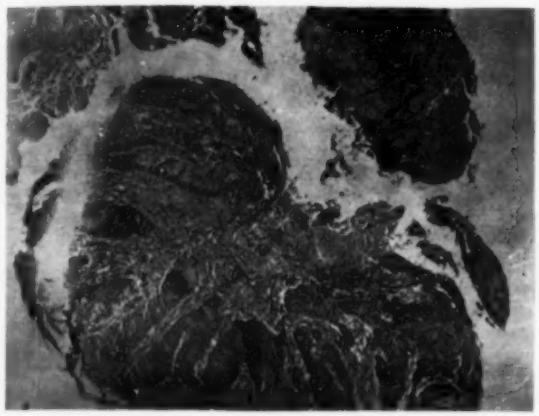

FIG. 648.—*Case* 4. Section showing differentiated squamous carcinoma. (× 24.)

FIG. 650.—*Case* 5. Left lateral view of operation specimen, showing carcinoma of left pyriform fossa cut across.

Dec. 2, 1947: A 16 Eng. bougie, but not an 18 Eng. bougie, could be passed through into the œsophagus.

Feeding by mouth has never been re-established, but she has survived and lives quite happily with the gastrostomy. She is sure she swallows ice cream and chocolate when she sucks it.

Case 5.—A man, aged 68, was admitted to University College Hospital, London, complaining of soreness of the throat for four months, and increasing dyspnœa and huskiness for six weeks. On direct laryngoscopy the left arytenoid and aryepiglottic fold were red and œdematous. The left vocal cord was intact but almost immobile.

FIG. 649.—*Case* 4. Specimen of tumour removed at operation.

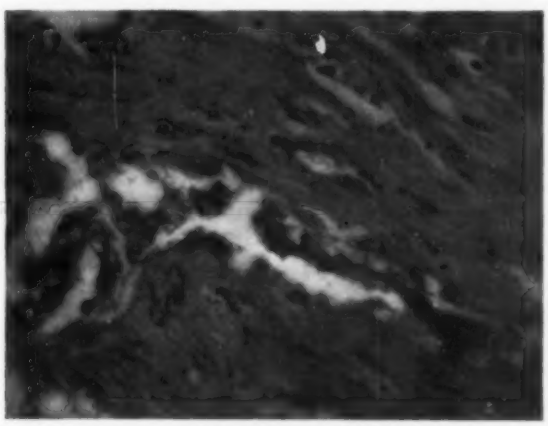

FIG. 651.—*Case* 5. Section of tumour showing undifferentiated carcinoma cells infiltrating muscle. (× 287.)

Feb. 2, 1947: Total laryngectomy and partial excision of the pharynx with primary closure of the pharyngo-œsophagus was done. A feeding tube was used, at first indwelling, then passed for each feed. A week later a gastrostomy was done as there had been trouble introducing the feeding tube and there was still a leak from the pharynx. It was dry from the following day onward, so he could have managed without the gastrostomy as events turned out. The tumour was squamous carcinoma, grade 4, freely infiltrating muscle (*Figs.* 650, 651).

June 12: He complained of a slight soreness on swallowing, radiating to the left ear. In view of the anaplasia of the growth, the cervical gland areas were irradiated by Dr. Gwen Hilton, though no local lesion was ever found.

At the time I last saw him in January, 1948, he did not seem well, but we could find no reason for this. In May, 1948, his condition had deteriorated, and he was readmitted to hospital by Dr. Gwen Hilton, and died in June, 1948. Autopsy showed a lung abscess due to an inhaled swab, but no evidence of recurrence of the carcinoma on minute examination.

Case 6.—A man, aged 57, was admitted to University College Hospital, complaining of one month's soreness of the throat and three days' dysphagia. He had a large

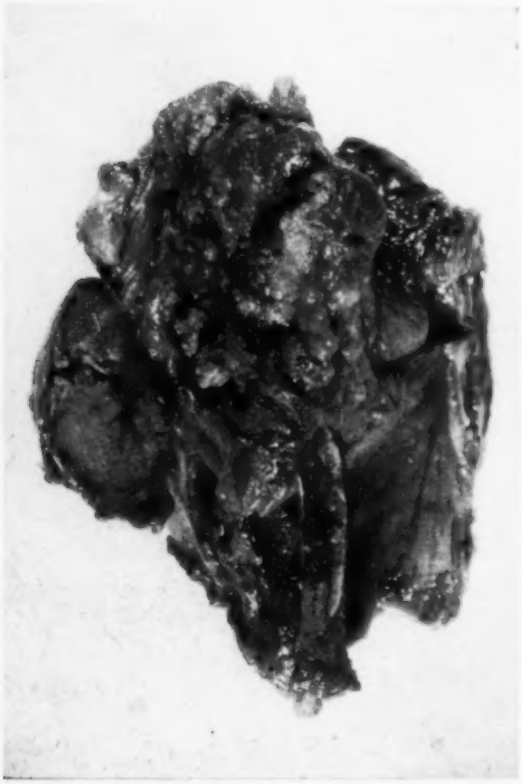

FIG. 652.—*Case* 8. Larynx excised, showing carcinoma of the left pyriform fossa, and a secondary node in an adjacent lymph-gland.

fungating growth of the posterior pharyngeal wall, the upper level of which could be seen on depressing the tongue with a spatula. There was a palpable gland at the bifurcation of the left carotid artery.

A gastrostomy was done on Feb. 9, 1947, and his septic teeth were cleared. The patient was very anxious for something to be done, whatever the risk.

March 2: After preliminary tracheotomy, using the right lateral pharyngotomy approach, the whole posterior pharyngeal wall from the level of the palate to the entrance of the œsophagus, together with the glands, thyroid cartilage, and the right lateral lobe of the thyroid gland were removed in one mass. The section was grade 2 squamous carcinoma.

March 18: Dissection of cervical glands in the left side.

The stage of convalescence merged almost imperceptibly into that of recurrence, and he died on April 29. Autopsy showed infiltration of the base of the tongue and prevertebral tissues.

Case 7.—A man, aged 72, was admitted to the Mater Misericordiæ Hospital, Brisbane, complaining of a husky voice for five months. For four months he had had a swelling of the left side of the neck. He had a large hard, but mobile, mass in the left side of his neck, and a small mobile gland in the right side of the neck. A carcinoma was seen in the lower posterior surface of the arytenoids and adjacent left lateral pharyngeal wall extending downwards for 1½ in. Biopsy showed undifferentiated papillary epithelioma.

July 26, 1951: Preliminary tracheotomy. A large glandular mass including the vagus, accessory, and phrenic nerves, which passed through it, was peeled off the bifurcation of the common carotid artery. In view of his general condition, removal of the primary tumour was deferred.

Aug. 9: Skin incision and left lateral pharyngotomy incision reopened. The patient was most anxious that the larynx be preserved, so the tumour was dissected off the back of the larynx together with the adjacent part of the left lateral pharyngeal wall.

Sept. 5: Limited gland dissection on the right side of the neck, and closure of the pharyngotomy.

The pharyngotomy broke down with recurrence of tumour at the original site. The tracheotomy had to be retained the whole period he was in hospital owing to glottic stenosis, and he died Dec. 13.

Case 8.—A man, aged 75 years, was admitted to the Mater Misericordiæ Hospital, Brisbane, complaining of foreign-body sensation in the left side of his throat for seven weeks and some loss of weight. At times food was difficult to swallow and the voice weak. Indirect laryngoscopy showed a growth in the left pyriform fossa.

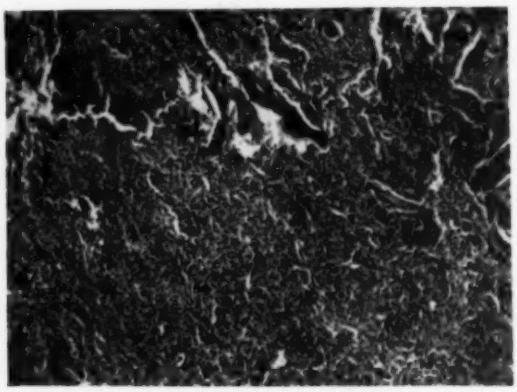

FIG. 653.—*Case* 8. Section showing undifferentiated squamous carcinoma. (× 50.)

The mobility of the left vocal cord was unimpaired. A gland was palpable in the left side of the neck.

Nov. 17, 1955: Total laryngectomy with removal of adjoining left lateral pharyngeal wall, left internal jugular vein, gland tissue, left lobe of thyroid gland, and left submaxillary salivary gland in one mass was done, with primary closure at the pharyngo-œsophagus (*Fig.* 652). Section (*Fig.* 653) showed squamous carcinoma, grade 3–4. One of the three lymph-glands sectioned showed a carcinoma deposit 1 cm. in diameter. No pharyngeal leak occurred after the eleventh day. The only difficulties were intolerance of the Colledge laryngectomy tube, and crusting in the trachea. The crusting was overcome by use of 'alevaire' in an atomizer. After three months the tube was omitted. The cough then cleared up. As he put on weight, the soft tissues tended to draw into the tracheal stoma. In September, 1957, I tenotomized the remaining fibres of the left sternomastoid and the stoma is now adequate.

He has remained well.

Case 9.—A man, aged 63 years, was admitted to the Mater Misericordiæ Hospital, Brisbane, complaining of a soreness and foreign-body sensation in the left side of his throat for four months. On the left lateral pharyngeal wall there was a plaque-like growth, covering an area the

size of a florin. The edge was indefinite both to direct vision and palpation.

March 6, 1956: *Left lateral pharyngotomy exposure after preliminary tracheotomy.* The left internal jugular vein and lymphatic tissues were removed, and no enlarged glands were seen. The posterior half of the left ala of the thyroid cartilage and the great cornu of the hyoid bone were removed. The pharynx was opened above and behind the growth. It was difficult to feel the extent of the growth through the pharyngeal wall. Clearance seemed doubtful behind the line, so a further strip of pharyngeal wall was excised, before continuing the excision. An area some 5 cm. in diameter was removed. The section was a grade 3 squamous carcinoma (*Fig.* 654).

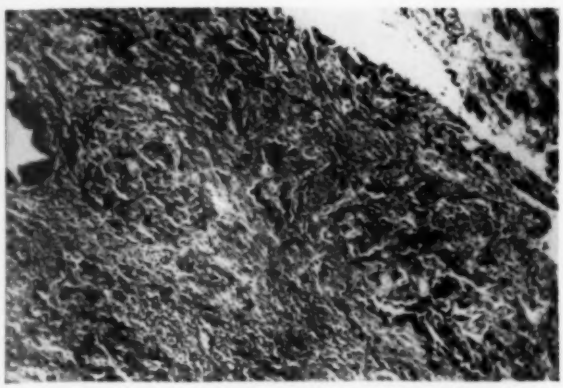

FIG. 654.—*Case* 9. Section showing poorly differentiated squamous carcinoma. (× 50.)

March 27: Pharyngeal fistula closed under local anæsthesia, and nasal feeding tube left in. He was most intolerant of the tube, the excessive salivation caused cough, and he blew the wound open again. A resuture was done on April 5, with a feeding catheter through the line of closure. The small pharyngeal fistula resulting after removal of the feeding tube was effectively plugged with a sponge-rubber pad, and normal feeding restored. He returned home on April 17. The small fistula persisted, and a repair was eventually successfully completed in his home town in November, 1956. He remains well.

Case 10.—A woman, aged 71 years, was admitted to the Mater Misericordiæ Hospital, Brisbane, with a history of swallowing difficulty for many years due to post-cricoid leukoplakia. For six months she had had pain and increased difficulty in swallowing. A direct laryngoscopy and biopsy had been done at another hospital and had shown a grade 2 squamous carcinoma in the post-cricoid area (*Fig.* 655), and X-ray films suggested that the growth extended into the thoracic area.

I could not see the upper edge of the tumour by indirect laryngoscopy, when asked to see her by Mr. Clement Windsor, to whom the patient had originally been referred with a view to combined thoracic and cervical approach.

March 8, 1956: Preliminary left thoracotomy, tracheotomy, and laryngopharyngectomy. The upper part of the œsophagus was seen to be normal on inspecting the left pleural cavity. The neck was opened on the left side through a curved incision beginning over the jugular notch and extending along the sternomastoid muscle. The lower end of the tumour was readily identified. The trachea and œsophagus were cleared. The trachea was divided below the 4th ring and sutured to the skin at the lowermost corner of the incision. The œsophagus was divided, and the larynx dissected clear on both sides. The pharynx was opened between the hyoid bone and the thyroid cartilage, and laryngopharyngectomy completed. The œsophagus and pharyngeal stump were sutured to the margins of the skin incision, all raw areas being successfully covered by skin. *Fig.* 656 shows the excised laryngopharynx.

Mr. L. Swiss Davies made a thoraco-acromial skin-tube pedicle, and during convalescence a gastrostomy was done to avoid feeding tubes during the reconstruction.

May 17: A skin-tube junction was made between the œsophageal and pharyngeal stomata by dissecting up an ellipse of skin enclosing the two stomata and suturing the margins together with the skin inside out. The pedicle flap was detached from the chest and sutured into the gap in the cervical skin resulting from the skin-tube formation. It was not possible to cover more than the lower half of the defect without undue tension on the pedicle, so Mr. Davies covered the upper part with a Thiersch graft. The part of the skin covered by the Thiersch graft broke down, but the crucial lower half and its junction with the œsophagus healed by first intention.

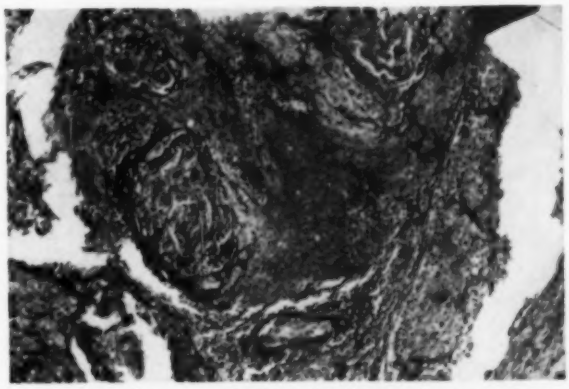

FIG. 655.—*Case* 10. Section showing grade 2 squamous carcinoma. (× 50.)

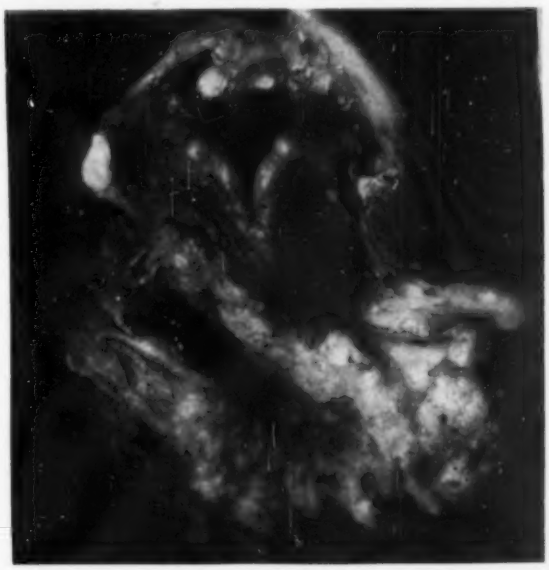

FIG. 656.—*Case* 10. Specimen of larynx, pharynx, and upper œsophagus removed at operation. The pharyngo-œsophagus has been split down the back to show the extensive growth encircling the gullet.

June 14: We resutured the skin-tube in its upper part, and after detaching the acromial end of the pedicle there was ample skin to close the neck defect soundly. Normal feeding was rapidly re-established. (*Fig.* 658.)

When seen a month later she was having trouble with mucous plugs in the trachea. 'Alevaire' in a throat spray dealt with this problem satisfactorily. A recurrence at the junction of the pharynx and upper end of the skin tube was irradiated with the linear accelerator in November, 1957. Feb. 12, 1958: No evidence of growth seen.

Case 11.—A man, aged 74, was admitted to the Mater Misericordiæ Hospital, Brisbane, complaining of soreness and aching in the right side of the throat, and pain on swallowing for seven months. He had not noticed an alteration in his voice, but some muffling was present when seen. He was a heavy pipe smoker, and had bad teeth. A carcinomatous ulcer was present on the back of the right arytenoid cartilage and laryngeal wall of the pyriform fossa. Loss of mobility of the right vocal cord was hardly noticeable. The neck on the right side of the larynx was visibly larger than on the left side, but no individual glands were felt. The remaining teeth were extracted three weeks before operation.

FIG. 657.—*Case* 10. First stage in reconstruction. The neck has healed by primary intention after laryngopharyngectomy. The pharyngostome, œsophagostome, and tracheostome are shown by arrows in that order from above downwards.

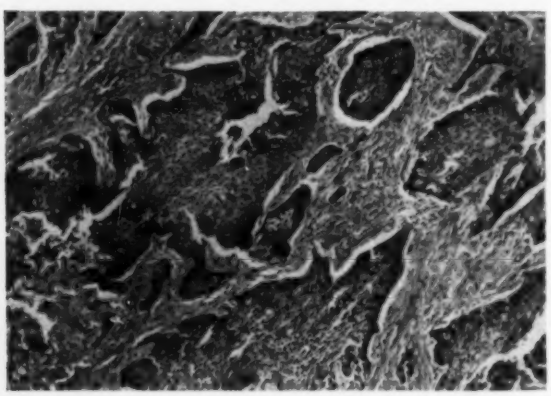

FIG. 659.—*Case* 11. Section showing grade 3 squamous carcinoma. (× 50.)

Aug. 6, 1956: Laryngectomy, with excision of the right lobe of the thyroid gland, lymphatic and fascial tissues, and a segment of the right internal jugular vein, in one block with the larynx. The right vagus nerve was accidentally divided, when the internal jugular vein gave way and had to be hurriedly ligatured. The lower part of the Gluck flap sloughed, and a pharyngeal fistula resulted. After two attempts with rotation flaps, this fistula eventually closed three months after laryngectomy.

FIG. 658.—*Case* 10. Shortly after complete reconstruction. The pharynx and œsophageal stomata have been included in a skin-tube fashioned from the skin of the neck. The resultant bare area has been closed by the tube pedicle from her chest wall.

The section (*Fig.* 659) showed grade 3 squamous carcinoma. Carcinoma was found in one of two large lymph-nodes removed. The tumour and the extent of glandular involvement was similar to that in *Case* 8, but on the opposite side of the larynx. A recurrent fistula high in the neck appeared about six months after laryngectomy, and was closed in two layers. He remains well.

MORBID ANATOMY

In *Cases* 1 and 10 the carcinoma was a post-cricoid tumour, but much more extensive in the latter. The tumours in *Cases* 2, 4, and 6 arose on the posterior pharyngeal wall, and on the lateral pharyngeal wall in *Cases* 3 and 9. These two groups may be classed together. The four tumours in *Cases* 5, 7, 8, and 11 arose in the pyriform fossa, on the left side in three and the right side in the remaining case.

There was little difference in the histological picture of the tumours arising in the post-cricoid and posterior and lateral pharyngeal wall groups. All, with the exception of *Case* 9, were well-differentiated squamous carcinomata. The pyriform fossa group by contrast showed little differentiation, and in *Case* 5 the carcinoma was anaplastic and infiltrating the muscle tissue. It was, therefore, not surprising that the microscopical involvement of glands was

found in three out of the four pyriform fossa carcinomata. Only 1 case from the other groups showed glandular metastases, and this (*Case* 6) was far advanced.

PRE-OPERATIVE TREATMENT

Clearance of infected teeth was required in 4 patients. The remainder were edentulous. The improvement in the patient's general condition and the local appearance of the growth following treatment of dental infection was striking.

Gastrostomy was done in 3 patients prior to excision of the carcinoma, and in another 4 it was done subsequently to facilitate repair and reconstruction. In 1 of these the decision was premature and gastrostomy could have been avoided (*Case* 5), in the other 3 gastrostomy could have been done with advantage before excision of the tumour. Many of these patients are starved and dehydrated, and an early gastrostomy improves the patient's condition very much.

ANÆSTHESIA

Except in the first two patients, where inhalation anæsthesia alone was used, all have been operated upon under intravenous anæsthesia supplemented by inhalation anæsthesia through a tracheotomy when the larynx has been conserved, and through a cupped intratracheal tube where the larynx has been removed. All received blood during the operation. I have always left this in the hands of the anæsthetist, who is the best placed in the theatre to say when and how much.

GENERAL CONSIDERATIONS

The larynx was wrongly conserved in *Cases* 1 and 7. In the first case of my series, I attempted to follow the earlier conception of Trotter and peel the tumour off the back of the cricoid. Life was prolonged, but restoration was never completed. In the seventh case the patient was most anxious not to lose his larynx. In view of the extensive bilateral gland involvement, I doubt whether a laryngopharyngectomy would have achieved a useful result. As it was, surgery failed to palliate his sufferings.

A good pharyngeal voice is so much better than that following extensive mutilation of the larynx, that there is little use in conserving it. Jesberg (1956) comments on this point. It is now generally agreed that total laryngectomy is necessary to get adequate clearance in post-cricoid and pyriform fossa carcinomata. If I had done this in the first patient, the end-result might have been very different.

THE GLAND DISSECTION

The tumours arising in the post-cricoid region and the posterior pharyngeal wall are situated in the midline, and the cervical glands on both sides are potential sites of metastases, but, as stated above, spread to the glands from these tumours is late. In these cases all the fascial and gland tissue was dissected on the side of exposure, but the internal jugular vein was preserved. This was done in order to avoid gross circulatory disturbance, should it have been necessary to sacrifice the jugular vein of the other side during a subsequent radical dissection of that side. It would appear from the work of Bocca (1953) that the fear of circulatory disaster is greatly exaggerated provided a 3–4 weeks' interval elapses before excision of the second internal jugular vein. In the two cases of these groups in which death resulted from carcinoma, it was due to the primary and not to glandular metastases. In *Cases* 2, 3, 4, and 10 no gland dissection was undertaken on the side opposite to the side of exposure, and no evidence of infiltration of the gland tissue removed during exposure and excision of the tumour was found histologically. No subsequent glandular involvement occurred in *Cases* 2, 3, and 4, and *Case* 10 remains free so far. Perhaps I have been more fortunate than I deserve. By contrast, I have had glandular metastases in 4 patients following laryngectomy for glottic carcinoma. In *Case* 9, a strictly lateral wall tumour, the internal jugular vein was removed with the gland tissue.

In the pyriform fossa group the chances of macroscopical involvement of the lymph-glands on the side of the lesion are very high. Only in the first case, *Case* 5, of this group were the glands not involved. In the light of subsequent experience, nevertheless, the internal jugular vein and glands should have been removed with the larynx. In the remaining three, the internal jugular vein, part of the sternomastoid muscle, and all the fascial tissue surrounding the great vessels and the submaxillary salivary gland were removed.

The high incidence of gland involvement in both the pyriform sinus tumours and the cancers of the glottis is shown in the series of Ormerod and Shaw (1956).

POST-CRICOID CARCINOMA TOTAL LARYNGOPHARYNGECTOMY

In *Case* 10 I followed the same plan that I had used in the 3 patients of the posterior and lateral pharyngeal-wall group, where resection of a complete segment of the pharyngo-œsophagus had been necessary. The method described by Wookey (1948) could equally well have been used, and would have provided a gutter joining the pharyngeal and œsophageal openings. The method used in this patient, though not providing a gutter, allowed primary closure of the operation field with skin-flaps, without having to rely on Thiersch skin-grafts. The period from primary excision to normal feeding, which may be called the period of restoration, was 3½ months. This period might have been shortened by using a Wookey gutter or a plastic tube (Owen and others, 1950; Dunlop, 1952), but there are many 'ifs' whichever method is used.

Shortly after the laryngopharyngectomy in *Case* 10, I had the privilege of assisting Mr. John Lynch to remove a laryngopharynx of an extensive post-cricoid carcinoma with extension into the neck, and we used a plastic tube to unite the pharyngeal œsophagus with primary closure of the skin-flap. Normal feeding was established immediately and maintained until death from hæmorrhage due to local recurrence. As a palliative the plastic tube was a great success, but had there been a better chance of operative cure and the patient survived, it would have taken some considerable time before the epithelium of the pharynx and œsophagus could have united along the length of the plastic prosthesis.

Som (1956) has described an ingenious method of conserving the anterior half of the larynx to form part of the circumference of the new gullet. In *Case* 10 it would not have been possible to get a safe clearance by this method.

CARCINOMA OF THE POSTERIOR AND LATERAL WALLS OF THE HYPOPHARYNX

These tumours arising in the posterior and lateral pharyngeal walls form the most promising group for excision. They tend to be well differentiated, do not metastasize early, and no not cross the prevertebral fascia until well advanced. They lie clear of the laryngeal skeleton, and the larynx can be left intact. A tracheostomy through a transverse incision before beginning the pharyngotomy is advisable, and should be retained until all œdema has subsided, usually 5 to 7 days after the operation. These tumours tend to encircle the gullet, and to get adequate clearance it may be necessary to remove a whole segment of the pharyngo-œsophagus. This was required in *Cases* 2, 3, and 4. The mucosa of the pharyngeal and œsophageal stumps is sutured into the line of the skin-flaps (*Fig.* 644). *Case* 6, which falls into this group, was strictly inoperable, and resection was only undertaken at the patient's urgent request.

The carcinoma in *Case* 9 was removed by the classical lateral pharyngotomy operation of Trotter. It was difficult in this case to determine the extent of the tumour by palpation of the yet intact pharyngeal wall, after the preliminary gland dissection and exposure of the pharyngo-œsophagus. This was due to the plaque-like shape, with no infiltration in depth of the pharyngeal wall. As a rule, these hypopharyngeal tumours can be readily palpated through the pharyngeal wall, which is a great help in determining the point at which the pharynx is to be opened. Primary closure of the pharynx has been advocated in lateral wall tumours, but both Trotter (1913) and Colledge (1943) invariably sutured the divided mucosa of the pharynx to the skin-flaps, and closed the fistula in two layers at a later stage. This is much the safer procedure, and in *Case* 9 the amount of pharyngeal wall removed in order to give a safe margin to the growth would have rendered primary closure difficult if not impossible.

RESTORATION OF CONTINUITY AFTER RESECTION OF COMPLETE SEGMENT OF PHARYNGO-ŒSOPHAGUS

Cases 2, 3, and 4 required a skin-tube junction between the pharyngeal and œsophageal stoma. The method used was similar in all three, and was used some years later in *Case* 10. Wookey had not published his work at the time these patients were submitted to operaton. His method would be equally applicable. When the larynx is intact, the problem of a tracheostomy in close relation to the œsophagostomy, and the difficulty in maintaining an adequate skin bridge between them does not exist, but at the completion of the plastic repair, the loss of the normal lateral food channel and sensory disturbance in the distribution of the superior laryngeal nerve may at first result in coughing, when oral feeding begins again, particularly with fluids.

The plan of reconstruction is shown in *Figs.* 644–647, and has been described previously (Suggit, 1953). In stage 1, a thoraco-acromial skin-tube pedicle is fashioned. This may be done as soon as the neck is healed following the excision of the tumour, which should occur in ten days from primary union. The pedicle is protected from saliva trickling down from the neck by a plastic apron secured with varnish to the chest wall above the pedicle. The pedicle should be left undisturbed for six weeks before proceeding to the next stage.

In stage 2, an ellipse of skin, 3 in. across at its shorter diameter, and enclosing the pharyngeal stoma above and the œsophageal stoma below, is dissected up, until the everted edges meet in the midline, thus forming a tube of skin enclosing both stomata. The two edges are closely sutured with catgut, as shown in *Fig.* 646. The thoracic end of the thoraco-acromial skin-tube pedicle is now divided and opened out. This end of the pedicle is now brought up to the neck, and shaped to fit the elliptical defect in the neck resulting from the formation of the skin-tube. The defect usually measures some 4×3 in. It is necessary to bring the forearm across the chest with the hand over the opposite shoulder to reduce the distance between the operation field in the neck and the point of fixation and blood-supply of the tube pedicle at the acromion. In *Case* 10 it was not possible to cover the whole area even with full mobilization of the forearm, and a second stage to complete the plastic became necessary.

The œsophageal stoma is small, and it is important, when dissecting up the ellipse of skin to form the skin-tube, to allow a wide margin round this stoma. Failure to do this was one of the factors in the subsequent fibrous stenosis at this site in *Case* 4. *Fig.* 657, *Case* 10, illustrates the closeness of tracheostomy and œsophagostomy, when the larynx has been removed with the pharynx. This increases the difficulty of getting an adequate margin of skin around the œsophageal stoma. It is better to take the line of incision closer to the tracheostomy than the œsophagostomy. The hand is held on the opposite shoulder by a broad band of strapping from the back over the dorsum of the hand, forearm, elbow, and upper arm to the shoulder of the donor graft. A pad is placed in the axilla. The patient must keep his fingers moving as much as he can, to avoid stiffness. This position must be retained for three weeks, but swallowing by mouth may begin after the tenth day if primary union is obtained.

In the third stage the excess pedicle is removed, and both the donor site at the shoulder and the grafted area in the neck are ' tidied up '. The result is shown in *Figs.* 647 and 658. *Fig.* 641 shows the X-ray picture of the new gullet in *Case* 2.

CARCINOMA OF THE PYRIFORM FOSSA

I have departed in recent cases from the strict Gluck technique as practised by Colledge, with a view to a better exposure of the gland area on the affected side and a more watertight field for the anæsthetist. The steps are :—

1. A U-shaped Gluck flap is dissected up and the fascial tissue covering the front of the larynx is removed.

2. The strap muscles are divided close in to the larynx on its sound side, and the pharyngo-œsophageal muscle-fibres separated from their attachment to the laryngeal skeleton. The isthmus of the thyroid gland is divided, and the lobe of the thyroid gland on the sound side is retracted from the operation field.

3. The sternomastoid muscle on the side of the tumour is divided, and the internal jugular vein is ligated and divided at its lower end. The œsophagus is exposed and separated from the trachea. The trachea is divided, the intratracheal tube being first withdrawn. The tracheal stump is sutured to the skin towards the side away from the tumour. A fresh-cuffed intratracheal tube is introduced and passed under the towels to the anæsthetist. It is not necessary to interfere again with the anæsthetic circuit until the skin sutures are introduced.

4. All the fascial tissue with the jugular vein is dissected away from the common carotid artery from below upwards, taking the lobe of the thyroid gland if this is suspect. When the level of the pyriform fossa is reached, dissection is continued behind, laterally, and above, so that the plane between the gland area and the pyriform fossa is not disturbed, until the gland tissues are attached only to the laryngeal skeleton.

5. The thyrohyoid membrane is divided on both sides, and the larynx brought forward out of the wound. The extent of the growth can now be accurately determined. The mucosa on the back of the cricoid cartilage is incised, and a pharyngeal cuff dissected away from the lowermost part of the larynx and trachea.

By this method, the tumour and gland area are removed in one continuous block.

OPERATIVE MORTALITY

There were no operative deaths in this series of 11 consecutive cases. It is possible that in *Case* 5 the lung abscess could be a long-term result of the operation, but the swabs were correct in the theatre, and there were many opportunities for a swab to enter the trachea in the subsequent months. It shows the importance of using only large pieces of gauze in the dressings and toilet of patients following laryngectomy.

SLOUGHING OF THE FLAP

In *Case* 11 the lower part of the Gluck flap sloughed, resulting in a pharyngeal fistula, which eventually closed following a sliding skin-graft. This has also happened in one of my cases of laryngectomy for carcinoma of the glottis, previously irradiated, but it is an unusual complication, as the U-shaped flap has an excellent blood-supply.

POST-OPERATIVE CHEST COMPLICATIONS

There were no significant post-operative chest infections in this group, except in *Case* 11, where leak from the pharyngeal fistula on two occasions was followed by pyrexia and purulent sputum. Penicillin and suction were big factors in avoiding serious chest complications, but great credit reflects on the nursing.

POST-OPERATIVE CARE OF THE STOMATA

When the larynx has been excised, a Moure's modification of Lombard's tube is placed in the tracheostome. This is changed three or more times daily, as the amount of saliva leak demands, and all secretions on the wound and in the trachea are removed by suction. The amount of leak is usually most around the fourth and fifth days. If healing by first intention is occurring, the leak then takes up rapidly, and a Colledge's laryngectomy cannula replaces the large Moure's tube. The nursing staff at the Mater Misericordiæ Hospital now use plastic tubes in place of the four tapes on the Moure's tube. Two separate colours are used, one for the two inner plastic tubes tying the tube into the stoma, beneath the dressing, and the other colour for the two outer plastic tubes tying the dressing on to the neck. The colours are a help in tying the right plastic tubes together when changing dressings at night in a poor light. The lengths of plastic tubes are readily sterilized, and the clean Moure's tube is assembled complete with gauze dressings and plastic tubes ready to introduce as soon as the dirty one is removed.

Throughout this series, a buffer gel *p*H 8, a sodium hydroxide solution buffered by potassium dihydrogen phosphate, has been used. The gel, originally developed at Harefield Hospital for protection of gastrostomies against gastric juice reflux on to the skin, has been used not only for protection of the œsophageal stoma from any reflux, but also to protect the tracheostomy and pharyngostomy from the irritant action of the saliva.

When the pharyngeal fistula persists, sponge rubber often makes an excellent dressing and can often be attached to the laryngectomy tube in such a way as to plug the saliva leak and make the patient more comfortable pending plastic closure.

After two months no laryngectomy tube is necessary in most patients, and the uppermost ring of the trachea forms a firm margin to the stoma. An unexpected difficulty arose in *Case* 8. He put on weight rapidly after the growth was removed, and his neck tissues overflowed the stoma and tended to be sucked in. He was most intolerant of a Colledge tube and preferred to persevere without one. A tenotomy of the remaining fibres of the left sternomastoid, done 22 months later, relieved the obstruction.

When an œsophagostome is present, particular care is necessary to avoid excoriation and stenosis. The opening is never large, even when the œsophagus has united with the skin of the neck by first intention. *Case* 4 suffered this complication, and an 11-year survival has been marred by its results.

THE NASAL FEEDING TUBE

In nasal feeding the tube remains in until saliva ceases to appear at the suture line and water can be drunk without leak. If the pharyngeal fistula persists for more than two weeks, the tube is changed, using the opposite side of the nose for preference. Once the worst of the saliva leak is over, I always give the patient the option of passing the tube himself for each feed, or retaining it continuously. Most prefer to retain the tube in position, and become very tolerant of it. *Case* 9 is the one exception. During

the few days after closure of the pharyngeal stoma, he complained of constant irritation and cough, eventually bursting the wound open.

RE-ESTABLISHMENT OF NATURAL FEEDING

When the larynx has been removed, and healing of the gullet is complete, with or without a skin-tube, no problem arises provided stenosis in the line of repair is avoided. There is only one route for the food to take, and the loss of muscular wall does not seem to matter much. The resection of a good deal of the pharynx necessary to get adequate clearance in laryngectomy for pyriform fossa carcinoma may be followed by difficulty in swallowing large particles. *Case* 8 had some difficulty at first, but feeding was much improved after passing the larger sized œsophageal bougies.

When the larynx is retained, some difficulty at first is usual. One factor is loss of the lateral food channel on the side of the operation, and considerable interference with the mechanical working of the opposite side, when a complete skin-tube replaces a segment of the pharynx. The other factor is the loss of sensation on the side of entry due to division of the superior laryngeal nerve, and spilling into the glottis. Fluids give more difficulty than solids, which suggests the sensory loss is more important than the mechanical disarrangement.

The best method is to begin with fairly solid food by mouth, and retain the gastrostomy for addition of adequate fluids. Eating at first is a laborious process, but improves from day to day. It may take a month before the intake of fluids by the oral route is sufficient to allow the gastrostomy to close.

PHARYNGEAL SPEECH

When the larynx has been sacrificed, the acquisition of pharyngeal speech is essential for complete rehabilitation. I have found as stated by Raven (1954) that the patients have greater difficulty in learning pharyngeal speech when the pharynx is also removed, even when this removal is partial, as in resection of pyriform fossa tumours, than they do after laryngectomy in glottic carcinoma. In glottic carcinoma the separation of the pharynx can follow close in to both arytenoid cartilages as a rule, and the cricopharyngeus muscle bundle is more or less retained. More extensive resection of the pharynx destroys the effective sphincter action of this muscle, which seems to play quite a big part in acquired pharyngeal speech.

In this series, *Case* 8, the eldest of them, developed the best voice. There is great individual variation in the ease with which different patients learn.

TRACHEITIS

After laryngectomy the trachea receives a cold unfiltered air stream. When the laryngectomy tube is discarded, and a collar and tie are worn, a fair degree of protection is provided, but exposure to cold winds and driving in an open car are particularly likely to set up a tracheitis with bleeding from the mucosa and crust formation. Both *Cases* 8 and 10 had trouble with crusting in the first few weeks after laryngectomy. 'Alevaire' in an atomizer, sprayed into the trachea, gives great relief.

BRONCHOPNEUMONIA

Bronchopneumonia is here used to mean the incidence of the disease in the rehabilitated patient, and not as a post-operative complication.

Laryngectomy patients are more prone than the average to bronchopneumonia, for the reason given above. One of my patients, who had his larynx removed for a glottic carcinoma six years ago, has had two attacks during this time. The only bronchopneumonia in this series was in the second case, in which the larynx was not removed. Cinéradiography of this patient at 5½ months after operation showed an occasional trace of barium spill into the trachea, but she had no feeding difficulties up to her last visit not long before she died two years after resection of the growth. Though a pneumonia due to inhalation of food particles was possible, I think it was unlikely.

SURVIVAL

Survival figures are shown in the following table :—

	Post Cricoid		Posterior and Lateral Walls of Pharynx				Pyriform Fossa		
No. of years survival	1	2	Less than 1 yr.	2	8	11	Less than 1 yr.	1	2
Died of carcinoma	1		1				1		
Died of other causes :									
Broncho-pneumonia				1					
Lung abscess								1	
Coronary occlusion					1				
Alive and well		1		1		1		1	1

I am indebted to many friends on the honorary and resident staffs of the three hospitals concerned, only a few of whom I have named. My greatest debt is to the ward sisters and nurses. I gratefully acknowledge the loan of blocks for six of the illustrations to the Editor, Mr. F. W. Watkyn-Thomas, and the publishers, H. K. Lewis & Co., of *Diseases of the Throat, Nose and Ear*.

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SURGICAL PROBLEMS IN THE TREATMENT OF HYPERPARATHYROIDISM

By NORMAN WYNDHAM, Sydney

MATERIAL

This is an account of difficulties encountered by a general surgeon on the staff of a hospital where the treatment of parathyroid disease is not a special feature. Some of these problems may be resolved with increased experience but they are likely to be the cause of anxiety to others besides ourselves. The material is made up of 9 cases, 7 of which were investigated at the Royal Prince Alfred Hospital, Sydney. Of these, 1 was investigated by Dr. E. M. Day, Consultant Biochemist, and 6 by Professor C. R. B. Blackburn, working in the Clinical Investigation Unit. The large amount of careful work done by them is not recorded here, being unrelated to the purpose of the paper.

DIAGNOSIS

In none of these cases was the correct diagnosis considered early in the disease. The patients with renal calculi as the only manifestation gave the longest history, one of ten years' and another of thirty-three years' duration. Whether the calcium and phosphorus metabolism was disturbed from the beginning of symptoms is unknown. The shortest histories were given by those with severe disturbance of bone—namely, two and three years. Both of these patients were women with marked kyphosis, a pathological fracture, widespread osteitis fibrosa, and renal calculi.

It seems that cases of parathyroid adenoma exist without being suspected. It is strange that this small group includes the majority of cases of this disease treated in Sydney. That they should have been found only during the last ten years suggests that others must have existed during the same period and prior to it. The assumption is that the diagnosis is not thought of when cases of asthenia, renal calculus, polyuria, or bone disease present themselves. This criticism is only partly correct. Over a period at our hospital hundreds of cases of renal calculus were investigated by Dr. Day relative to the calcium metabolism with negative results, and all doubtful bone conditions were likewise investigated without any cases of osteitis fibrosa cystica or other manifestations of parathyroid disease being found.

It may take some time before the diagnosis is arrived at, but it must be made with certainty before operative surgery is undertaken. On one occasion the writer was persuaded to explore the neck of a patient in the faint hope that an adenoma would be found. This was not a case in our own hospital. When performed on doubtfully valid biochemical findings it is a most unsatisfactory procedure. The necessity for certainty in diagnosis will be referred to later when the question of mediastinal exploration is discussed. In this chronic disease no harm will come to the patient if some weeks are spent in careful investigation. This is most necessary in mild cases. Black (Black and Zimmer, 1955) found that in 13 per cent of cases the serum-calcium was less than 11 mg. per 100 ml., while Allbright and Reifenstein (1948) had only 1 such case in 35 patients, although 9 had values of less than 12 mg. per 100 ml. The latter have shown the importance of correlating the serum-calcium level with that of the serum-protein. Even under standard dietetic conditions the serum-calcium and serum-phosphorus levels may vary inexplicably in any one case, but there is no reason why an adenoma should function at a constant level of activity. In the following case variations occurred in the level of phosphorus in the serum which were hard to explain and raised the possibility of some other diagnosis being the correct one.

Case 1.—F. G. S., a male, aged 48, had suffered from renal calculi for thirty-three years before any detailed calcium metabolic studies were carried out. There was no X-ray evidence of disturbance of calcium deposition or absorption of bone, the acid and alkaline phosphatase levels in the serum were normal, and the renal function was normal. The results of the preliminary investigations included the following :—

Date	*Serum Ca*	*Serum P*	*Serum-protein*
May 10, 1955	13·0 mg./100 ml.	2·2 mg./100 ml.	8·1 g. per cent
May 16, 1955	11·6 "	2·45 "	7·45 g. "
May 30, 1955	15·0 "	3·85 "	8·0 g. "
July 8, 1955	12·9 "	2·63 "	8·1 g. "

On July 14, 1955, exploration of the neck and upper mediastinum was carried out. The two upper parathyroid glands were identified and an enlarged right parathyroid gland found in the chest anterior to the right innominate vein. The left lower gland was not seen but the enlarged right lower gland, which was normal in appearance, was removed since such glands may contain an adenoma (Cope, 1941). It did not, however, reveal any adenoma. It consisted mainly of packed oxyphil cells as well as representatives of all the other types of parathyroid cell. The case was thus a surgical failure. Post-operatively he was well for the first week until serious infection in his wound ushered in a period of profound mental disturbance and semi-coma. There was no indication that this was due to his parathyroid abnormality itself. He was extremely ill for five weeks before he recovered. Subsequent investigations confirmed our belief that an adenoma had been left in the neck or chest. The pertinent findings were :—

Date	*Serum Ca*	*Serum P*	*Serum-protein*
July 25, 1955	11·2 mg./100 ml.	2·6 mg./100 ml.	6·7 g. per cent
Aug. 25, 1955	11·4 "	3·58 "	9·6 g. "
Sept. 28, 1955	11·8 "	4·0 "	7·5 g. "
Oct. 8, 1955	11·6 "	3·8 "	
Oct. 28, 1955	11·7 "	3·2 "	8·0 g. "
Nov. 25, 1955	13·0 "	3·46 "	7·8 g. "
April 6, 1956	12·2 "	2·48 "	8·05 g. "

The reasons for the variations in serum-phosphorus levels were not clear but seemed in some way to be associated with his toxæmia.

OPERATIVE DIFFICULTIES

1. Anæsthesia.—An obvious though unusual difficulty arose in one case owing to the distortion of the skeleton (*Fig.* 660).

Case 2.—M. L., a married woman of 47 years, was admitted under the care of Dr. A. W. Morrow on Jan. 9,

1950. A right nephrectomy had been performed two years previously for renal calculus, after which she felt well for twelve months. At this time, a year before admission, she suffered pains in the four limbs and a gross and rapid deformity of the skeleton. Her appetite became poor and she lost weight. She had not been able to walk for nine weeks prior to her admission to hospital. In childhood she had had a cyst removed from the right femur, the exact nature of which was unknown. The immediate cause for admission to hospital was an inability to pass urine. Investigation revealed the following: serum-calcium 16·4 mg./100 ml., serum-phosphorus 0·9 mg./100 ml., serum-protein 6·8 g./100 ml., and alkaline phosphatase 22·2 King Armstrong units per 100 ml.

FIG. 660.—*Case* 2. Photograph showing a problem in anæsthesia.

X-ray examination revealed a generalized osteitis fibrosa and an unsuspected pathological fracture of the right femur. The fæces gave a very dense shadow (*Fig.* 661) compared with the bones, so that the radiologist thought that a barium enema had been given. This was certainly not so. There was no indication for it, the patient was too sick for unnecessary investigations, and the skeletal deformity would have made its administration very difficult.

Operation was carried out under local anæsthesia on Jan. 31. An adenoma 2·5 cm. in diameter was found in the position of the left inferior parathyroid gland. Despite the severity of her illness and the gross disturbance of her calcium metabolism, her immediate post-operative condition was good. She required only small additional amounts of calcium and indeed this, our first case, was treated with a relative lack of caution which horrifies us now after more recent experience. The serum-calcium level fell slowly so that it was not quite normal a month later. The Sulkowitch reaction of the urine was negative by the ninth day. The alkaline phosphatase level rose to 60 King Armstrong units. She appeared to have recovered completely from the operation and was in the process of having her femur straightened when she suddenly developed an ascending infection of the renal tract, from which she died.

2. Anatomy.—Most operation difficulties are the usual and obvious ones determined by anatomy. We punctured the pleura in 1 case and in 2 cases failed to find the adenoma. This was indeed humiliating despite other surgeons having had the same experience. It is proposed to re-explore one case and, in the other, a small adenoma was found behind the superior vena cava by Cope of Boston. The patient had returned to America after the first stage. How to avoid this failure has interested many surgeons.

FIG. 661.—*Case* 2. Radiograph showing rarefaction of bone from generalized osteitis fibrosa, pathological fracture of the femur, and marked density of the fæces.

3. The Normal Gland.—It does not seem to us that the recognition of the normal gland is always easy. True, in thyroidectomy, one can always find at least three parathyroid glands, but our limited experience in parathyroid surgery, despite a not inconsiderable experience in other forms of neck surgery, has meant that in several cases we have not been able to recognize all four parathyroid glands. Possibly we are not alone in this. We did not remove any tissue in the offchance that it might possibly be parathyroid gland, to be identified by section after the operation. This procedure has been advocated. Biopsy by frozen section has been used freely for the purposes of confirmation, but we tried to avoid the risk involved of removing all parathyroid tissue. In our experience the non-adenomatous glands in these cases vary in appearance. Unlike those described by Cope (1941), most of the normal, i.e., non-adenomatous, glands were also normal in appearance and showed no evidence of compensatory hypofunction.

4. Location of the Adenoma.—Seldinger (1954) has used subclavian arteriography for the

localization of these tumours. The only time when the writer saw this method used successfully the adenoma was sufficiently large to have made its discovery at operation relatively easy. The same can be said of the case reported by Aird, Steiner, and Fraser (1956), in which inferior thyroid arteriography was performed at the time of operation. It is the minute adenoma which causes us concern. Black and Zimmer (1955) found that 22 per cent of adenomata in 120 cases weighed less than 0·25 g., which is smaller than the normal parathyroid. It would seem impossible to identify such a gland by arteriography.

It must also be difficult to trace these minute structures by following their blood-supply from the inferior thyroid artery (superior parathyroid adenomata are not hard to find), if in the mediastinum. In the case of one gland found in the anterior mediastinum no such vascular connexion could be demonstrated. This is in accord with Cope's experience. It is said that adenomata in the posterior mediastinum are found invariably with this vascular connexion demonstrable. The number of cases in which it is necessary to explore the mediastinum varies in different series. Of the Massachusetts General Hospital cases reported by Allbright and Reifenstein (1948), 10 per cent had adenomata in the anterior mediastinum and 8 per cent in the posterior mediastinum. On the other hand, Black (1954), of the Mayo Clinic, found that formal dissection of the mediastinum was necessary in only 2 out of 180 cases. He, however, explores the mediastinum digitally from the neck, a procedure which we have not had the courage to do thoroughly.

It may be wise to do this thoracic exploration as a second stage, as Gordon-Taylor (Gordon-Taylor and Handley, 1937), Cope (1941), and others have recommended, because of the time taken to explore the neck. This has been recommended also, so that the case may be reconsidered. We feel that the diagnosis should be so certain that mediastinal exploration can be advised unhesitatingly.

5. How Much to Remove?—Cope (1941) states that the size of the adenoma can be anticipated from the level of the calcium in the blood, while Seldinger (1954) believes that it is related to the degree of skeletal involvement. Allbright and Reifenstein (1948) warn against the complete eradication of the disease at one operation in patients with very high serum-phosphatase levels. They suggest that more recently they do not always follow this advice, presumably because of improvement in post-operative management. Also, in cases with multiple adenomata, one is sometimes left for the same reason. We regretted having removed all of one adenoma in one of our cases.

POST-OPERATIVE PROBLEMS

These are for the most part associated with the fall in serum-calcium. They may lead to tetany from hypocalcæmia. With more experience we hope to avoid this. Apart from partial removal of an adenoma in cases with high alkaline phosphatase levels in the serum or with much skeletal involvement, high calcium and low phosphorus intakes are essential, while frequent estimations should be made of the levels of calcium and phosphorus in the serum.

Success in the first and very ill patient who came under our care (*Case* 2) with marked osteitis fibrosa and who needed very little special treatment after her operation, gave the writer a false sense of security with consequent trouble in 2 cases.

Case 3.—M. P., a woman, aged 62, had suffered from inexplicable attacks of vomiting all her life. Five years before her admission she commenced to suffer from joint pains, and three years later lost her energy, became dyspnœic on exertion, and complained of a pressing pain in the chest and pain in the left thigh. The spine became grossly kyphotic. Her general health was very poor at that time. Six months before admission under the care of Mr. Hugh Barry she suffered a spontaneous fracture of the left femur. X rays showed a large cystic area at the site of the fracture as well as generalized osteitis fibrosa. The most important biochemical findings were: serum-calcium 15 mg./100 ml.; phosphorus 2·4 mg./100 ml.; serum-protein 5·7 g. per 100 ml.; serum alkaline phosphatase 43·2 King Armstrong units. After detailed metabolic studies were completed operation was performed on March 6, 1952. A left inferior parathyroid adenoma, 2 cm. in diameter, was removed. The upper right gland was very small and the right inferior normal in size and appearance. We were not certain as to the identification of the left superior gland. Post-operatively the serum-calcium fell immediately and by the sixth day, despite all treatment, hypocalcæmia was marked, the level falling to 6·8 mg./100 ml. Treatment was made difficult by persistent vomiting, and, although gastric suction was instituted, she inhaled vomitus and developed pneumonia which persisted until her death. Tetany developed eight days after operation, death occurring six days later. All forms of treatment failed to prevent the serum-calcium level falling to 5·3 mg./100 ml. on the day before her death.

This patient may have been saved had we performed a partial removal of adenoma, being guided by the degree of skeletal involvement and the size of the adenoma. The serum-phosphatase was moderately raised, but was unaltered by the operation. We were unable to find the cause of her vomiting both before and after the operation.

A patient with a different clinical and biochemical picture also gave cause for anxiety due again, perhaps, to lack of caution at the operation :—

Case 4.—M. S., a woman, aged 66, had been treated for five years for osteo-arthritis of the spine before the disturbance of her calcium metabolism was discovered. The important biochemical findings were: serum-calcium 12·4 mg./100 ml.; serum-phosphorus 3·05 mg./100 ml.; serum-protein 7 g./100 ml.; serum alkaline phosphatase 147 King Armstrong units. The last result was high in the absence of detectable bone changes but was confirmed on different occasions. We should have been warned by this and have considered performing a partial removal when the tumour was found to be 5·4 g. Immediately after operation the levels of calcium, phosphorus, protein, and alkaline phosphatase in the serum were 11·0 mg., 2·08 mg., 6·5 g., and 104 K.A. units per 100 ml. At the end of seven days the calcium had fallen to 8·6 mg. and the phosphorus to 1·62 mg. per 100 ml. Tetany developed on the thirtieth day when the values were calcium 5·9 mg., phosphorus 2·1 mg./100 ml., the serum alkaline phosphatase having fallen to 48·7 K.A. units. Complete normality was not reached in the serum until three months after the operation.

We found then in this case that hypocalcæmia may be quite profound in the absence of obvious skeletal changes.

SUMMARY

Hyperparathyroidism does not appear to be a common disease in Sydney, so that surgeons are unlikely to have a lot of experience in its management.

It is obvious that the operative problems are mainly anatomical, the diagnostic and post-operative ones biochemical. All the answers have not yet been given to the problems concerned with the localization of adenomata.

The post-operative course cannot always be foretold before operation.

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THE REPAIR OF INGUINAL HERNIA AND THE USE OF FILIGREES

BY LEONARD BALL

THE ALFRED HOSPITAL, MELBOURNE

IN the repair of inguinal hernia the condition of the muscle and fascial structures forming the inguinal canal is of great significance. In the case of a young man with good musculature and an indirect hernia of recent origin there is no doubt that the mechanism of the inguinal canal is efficient and cure of the hernia by removal of the sac is to be expected (Brandon, 1946 ; Patey, 1949 ; Doran, 1955).

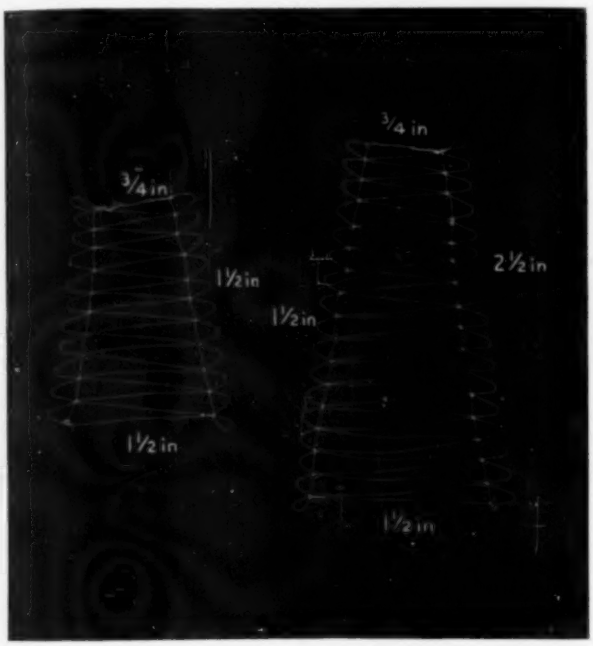
However, such perfect conditions for repair do not always exist and it is here that the problems arise. Hamilton Russell maintained that removal of the sac always brought about a cure provided that the excision was complete. In 1906 he wrote : " Hence it follows as a logical conclusion that early removal of the sac after the appearance of a hernia will constitute a radical cure of the condition and that recurrence will be impossible. It will also follow that the late removal of the sac after the abdominal wall has sustained much injury will probably prove a radical cure and recurrence will be unlikely to take place . . . for my belief is, that the recurrence even in the most unfavourable class of long-standing hernia will be so rare as to be practically unknown after removal of the sac has been performed with due care and in the best possible way." He retained very firm views about the importance of removal of the sac, but subsequently admitted that some direct herniæ were incurable by operation.

Hamilton Russell's optimism regarding the cure of hernia has not been justified, but his work did stress the importance of complete removal of the sac, especially in indirect hernia. It has been the experience of surgeons for many years that some method of repair is necessary for certain types of hernia, especially when there is a deficiency or atrophy of muscle and a stretching of tissues in the region of the internal inguinal ring. Since the pioneers of hernial repair, Bassini (1888) and Halsted (1893), first described their methods of repair, other surgeons have modified their operations or devised new ones, but in each case it has been a different method of strengthening the posterior wall of the inguinal canal—usually by fibrous tissue. Although in recent years Bassini's operation has often been criticized, it still remains the most common method of hernial repair, and some of the arguments used against this procedure do not appear to be altogether convincing (Turnbull, 1946).

Whether the internal oblique muscle and conjoined tendon are sutured to Poupart's ligament or Cooper's ligament, or whether or not the internal ring is transposed, the principle remains the same—that is, the strengthening of the posterior wall of the canal with muscle. It has been shown, by attaching radio-opaque markers (Doran and Lonsdale, 1949) to conjoined tendon and Poupart's ligament and by subsequent X-ray examination noting their gradual separation, that in at least a proportion of cases the muscle does not remain united to Poupart's ligament. Numerous reasons have been given for this failure to unite. It has been said that muscle will in no circumstance unite to a ligament, or that it is the areolar tissue on the muscle which prevents union (Koontz, 1951) and that if it is thoroughly cleaned off union may then occur. Others have pointed out that the internal oblique and conjoined tendon must always be under tension on account of its normal curve, and have recommended a relaxing incision in the rectus sheath to overcome this. It has been stated that union will not occur unless non-absorbable sutures are used, although others are equally emphatic that these sutures should be avoided as they cut through the muscle. Others have stated that sutures strangle the muscle and leave only fibrous tissue there. Whatever the fate of the muscle in this operation, I have observed on occasions, when operating in recurrent herniæ, that the conjoined tendon has remained united to Poupart's ligament through most of its length.

The posterior wall of the inguinal canal may be reinforced by plastic inserts (Thompson, 1948), tantalum filigrees, or stainless steel sutures, or by fibrous tissue when fascia lata or skin-grafts are used (Mair, 1945, 1946 ; Marsden, 1948). Then again silver-wire filigrees (McGavin, 1909) or floss-silk sutures not only strengthen the posterior wall of the inguinal canal by their presence, but being slight, tissue irritants stimulate the production of fibrous tissue. If we accept the proposition that the principle of these operations is the production of a

solid plaque of fibrous tissue, then it follows that we must use a material which is not inert ; that is, a substance which will produce some tissue reaction. Theoretically, at least, tantalum, stainless steel, and the plastics do not produce a tissue reaction and rely entirely for their success on their continuing presence at the site. The use of floss silk has the advantage that it is easy to use and does encourage the production of fibrous tissue. But a rather high proportion do get low-grade infections and, floss silk



A B

FIG. 662.—Illustrating 2 filigrees, A, standard size ; B, size usually used by the author.

being a multifilament material, infection will persist until the sutures are removed.

Silver-wire filigrees appear to be the best method of repair if properly used, and I believe that the method has fallen into some disrepute because of technical faults in the placing of the filigree. It must be placed in a properly prepared bed and kept perfectly flat. The silver wire does slowly disintegrate and therefore is a mild tissue irritant and stimulates the production of fibrous tissue. It is a monofilament material and the body can deal with any infection that may occur around it.

The method was introduced to the Alfred Hospital in Melbourne by the late R. C. Brown in 1912 and has been used constantly since that time. When first described by McGavin in 1909, and reviewed by Cole in 1941, it was recommended that a filigree $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$ in. (*Fig.* 662 A) should be placed superficial to fascia transversalis. A filigree of this length allowed the possibility of a gap medial to its inner end near the pubic tubercle and recurrences did occur here. Cole has discussed such recurrences and has used small oval filigrees to repair them.

For many years now it has been our practice to place the filigree deep to the fascia transversalis with the medial end behind the pubis and extending laterally to the internal ring. Thus the filigree would have to be longer and as a routine we use one measuring $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$ in. (*Fig.* 662 B). To place the filigree properly in position, perfect muscular relaxation is necessary, and it was originally recommended that a spinal anæsthetic should be used. Now, of course, with modern anæsthesia similar relaxation can be produced, but it is quite easy to place a filigree in position under local anæsthesia if a field block is used.

The technique is as follows (Ball, 1956) :—

1. Proceed with the operation in the usual way and completely remove the sac.

2. Raise the cord and hold it out of the operation field by two pairs of Morison's forceps.

3. Recognize the fascia transversalis, which is always a definite layer, and split it in the line of the incision parallel to Poupart's ligament. If any doubt exists as to the identity of this structure, it can be recognized by the fact that when it is cut the finger can be passed behind the pubis.

4. At this stage the inferior epigastric vessels often come into view, more especially if the internal ring is large and displaced medially. If seen they should be deliberately cut and ligated, as, if they are accidentally damaged, bleeding can be very troublesome.

5. Then place the filigree on the extraperitoneal tissues—to facilitate this I place a copper spatula, as wide as the filigree and bent about 6 in. from its end, through the opening in the fascia transversalis. This extends behind the pubis and rests on the peritoneum, and on this I place the filigree. A second spatula is put on top of the filigree and the deeper one removed, taking care not to displace the filigree.

6. Then sew the fascia transversalis over the filigree, and gradually remove the spatula. As this is done adjust the filigree so as to make the internal ring as small as possible. The filigree, however, is not fixed in any way.

7. Sew the conjoined tendon to Poupart's ligament behind the cord.

8. Replace the cord, close the external oblique, and repair the wound.

9. Apply a spica bandage. I have found a 6-in. flannel or flannelette bandage most suitable.

The patient is allowed out of bed as soon as he is reasonably comfortable and the spica taken off about the eighth day when the sutures are removed. No further treatment is necessary, but he should rest for about one month.

Since 1945 over 1000 patients with inguinal hernia have been operated on by me and my associates at the Alfred Hospital, the Repatriation Hospital, and in my private practice. Of these, 44·5 per cent have had a filigree repair done on them. This may seem a high proportion, but the type of hernia now presenting at either a public or the Repatriation Hospital is not, by any means, truly representative of the herniæ of the community. In Victoria there is a Worker's Compensation Act which is interpreted very liberally with regard to hernia, " arising out of or in the course of their employment ". As a result practically all adults of the working population who develop a hernia become the responsibility of insurance companies and are not admitted to public hospitals. Most of these are healthy young adults

with congenital sacs and with good musculature, healthy tissues, and a well-functioning inguinal mechanism.

In public hospitals, on the other hand, the type of patient presenting with a hernia is the one with a long-standing condition, or old men with poor musculature. Similarly, in repatriation practice there are two main groups—those with recurrent hernia after operation while on service, and the invalids and old men who are for various reasons "totally and permanently incapacitated" and thus eligible for treatment of hernia whenever arising.

There is thus a group of nearly 500 patients who have had a filigree repair for inguinal hernia since 1945. Of these, one filigree has had to be removed, and that was in 1946. In this case a sinus persisted for ten weeks after operation. I removed the filigree, which I found to be crumpled, and replaced it at once with another lying perfectly flat. The wound healed by first intention. Even if infection occurs, a sinus will never persist if the filigree is perfectly flat. But it will persist if the filigree becomes bent at its edges and a 'nest' of granulation thus forms in and about it. No patient has complained of pain or discomfort due to the filigree, and none has been conscious of its presence.

The use of a second filigree, superficial to the cord and over the internal ring, but deep to the external oblique, as recommended by Cole, has not often been considered necessary. Had it been used it might, perhaps, have prevented one of the two known recurrences. In this case a left inguinal hernia was repaired with a short filigree 1½ in. long, which was placed behind the fascia transversalis. The medial end was placed behind the pubis and the filigree was therefore not quite long enough to extend right up to the internal ring. Five years later a swelling was noticed in the inguinal region, and at operation a loop of sigmoid was found to be prolapsed through the large internal ring. This was repaired by a second filigree placed under the transversalis muscle lateral to and superficial to the cord. Recently, two years after his second operation, the man presented himself again, this time with a right inguinal hernia which was also repaired with a filigree.

In this series, which includes a large proportion of direct herniæ, the bladder has often been associated with, and intimately attached to, the sac, and on 3 occasions it has been opened. There have been no ill-effects from this, as the accident has been recognized, the bladder closed, and a urethral catheter tied in. A filigree has then been placed in position and the operation completed in the usual way. Three patients have been operated on with the diagnosis of direct hernia—one a recurrent one—and the entire bulge has been found to be bladder without any peritoneal sac (Stock, 1947). These, again, have been easily repaired with a filigree.

In reviewing 500 cases of filigree repair of inguinal herniæ done in the post-war years, in my own surgical units results have been uniformly good, and apart from one filigree which had to be removed, no unpleasant feature followed the operation. Attempts were made to get a complete follow-up of the cases operated upon, but owing to various circumstances, including poor records and the loss of certain operation books, there were too few patients who answered letters sent to them to be of any real statistical value.

However, I feel that this is an adequate number to give sufficient knowledge from which conclusions may be drawn. Then again I have had the benefit of the experience of surgeons who have used filigrees at the Alfred Hospital since 1912.

My own view is that this is the operation of choice in inguinal herniæ that need repair, and that if the filigree is kept flat and properly placed, then no unpleasant results will supervene.

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PARAPLEGIA DUE TO SPONTANEOUS EXTRADURAL OR SUBDURAL HÆMORRHAGE

By JAMES P. AINSLIE

DEPARTMENT OF NEUROSURGERY, ROYAL PERTH HOSPITAL

THE admission, since 1950, to the neurosurgical department of the Royal Perth Hospital, of 4 patients suffering from paraplegia due to compression of the spinal cord by either an extradural or subdural hæmatoma in the absence of a history of trauma or any demonstrable pathological lesion, apart from arteriosclerosis, suggests that insufficient attention has been given to this cause of paraplegia.

In 1953, Sadka, of this department, recorded 2 patients suffering from paraplegia due to spontaneous extradural hæmorrhage, and reviewed the case histories of 12 patients previously recorded in the literature. In 9 of these cases trauma, even though of a minor nature, could have been of aetiological significance.

Since then 1 further case of paraplegia due to compression by an extradural hæmatoma and 1 due to compression by a subdural hæmatoma have been admitted. These 2 patients, together with the 2 previously recorded by Sadka, form the basis of this report.

Study of these 4 cases shows they present an almost uniform pattern of symptoms, which should lead to a correct diagnosis provided the possibility of the condition is considered.

All patients were over 60 years of age; all were known to be suffering from hypertension; the onset of the condition was in each case characterized by dramatic suddenness suggesting a vascular lesion and occurred in the absence of any trauma or associated effort.

In each case the initial symptom was acute pain localized to an area of the spinal column, which was subsequently found to be the site of the maximum extent of the hæmatoma. This back pain was followed by pain of a radicular pattern, and symptoms of compression of the spinal cord developed immediately or more slowly over a period of hours or days.

Three points are emphasized: the condition occurred in elderly patients, in patients suffering from hypertension, and in the absence of trauma or muscular effort—conditions commonly present in intracranial hæmorrhage due to arteriosclerosis.

The first patient was returning to bed after having got out of bed to pass urine, the second reclining in a chair, the third was walking in her home, and the fourth was quietly walking down the street.

Each patient suffered from hypertension, and in no case was there any suggestion of trauma or undue muscular exertion.

CASE REPORTS

Case 1.—Mrs. L. S., aged 73 years, was admitted to the neurosurgical department of the Royal Perth Hospital on Jan. 20, 1950. She had suffered from headaches for over twenty years, and had been told that these were due to hypertension.

On Jan. 19 she got out of bed to pass urine; on getting back into bed she experienced a violently severe pain in the middle of her back, and pain radiated to the lowest part of the abdomen and upper part of the buttocks. Almost immediately she was aware of numbness in her legs and inability to move her lower limbs.

On admission to the Royal Perth Hospital, thirty-six hours later, examination revealed an elderly woman, with signs of a complete lesion of the spinal cord below the level of the tenth thoracic segment. The blood-pressure was 200 mm. Hg systolic, and 100 mm. diastolic. Lumbar puncture had been performed ten hours after the onset of symptoms; this revealed clear cerebrospinal fluid, the pressure of which had not been recorded, but it was stated that normal response occurred on jugular vein compression. The cerebrospinal fluid contained 200 mg. per cent of protein, and 35 lymphocytes and 135 erythrocytes per c.mm.

Myelography revealed that the opaque medium injected below the fifth lumbar vertebra traversed the whole length of the lumbar and thoracic spine into the cervical region in an irregular manner.

Operation was performed immediately, the spinous processes and laminæ of the eighth, ninth, and tenth dorsal vertebræ being removed. This revealed an extradural hæmatoma completely filling the exposed extradural space and extending beyond the unroofed portion of the neural canal. The clot was removed, and a catheter passed upwards and downwards in the extradural space. Irrigation with saline washed out large pieces of blood-clot, both from above and below the site of operation.

Post-operatively there was no recovery of function and death occurred four months later from complications of paraplegia.

Case 2.—Mr. W. G., aged 70 years, was admitted on Nov. 3, 1952. Some months previously he had consulted his doctor because of headache and shortness of breath on exertion. He was found to be suffering from hypertension, with a systolic pressure of 210 mm. Hg, and a diastolic pressure of 120 mm. His weight was 17 st. He received treatment, and on Oct. 29 reported to his doctor stating that he was feeling "on top of the world". His weight had been reduced to 15 st. Later in the same day he spent some time trimming his hedge. That evening, while resting quietly in a chair, he was suddenly seized with severe pain in the lower part of the cervical spine and pain radiated down the medial aspect of both upper limbs to the ulnar aspect of both hands. The following day his legs felt heavy and awkward and the next day he remained in bed because of the severity of the pain. While in bed he found it increasingly difficult to move his lower limbs and suffered no pain due to second degree burns of both feet from a hot-water bottle.

He was admitted to hospital six days after the onset of severe pain. Examination revealed a stout elderly man with a complete flaccid paralysis of the lower limbs and abdominal musculature, and with paralysis of the intrinsic muscles of both hands. There was no perception of any form of sensation below the level of the seventh cervical segment. Lumbar puncture revealed clear cerebrospinal fluid at a pressure of 80 mm. of water and a satisfactory response to jugular compression. The fluid contained 8 lymphocytes per c.mm., and 172 mg. per cent of protein.

Radiography of the cervical spine revealed gross cervical disk degeneration and advanced spondylitic changes in this area. Myelography by the lumbar route revealed an irregular filling defect in the lower cervical

FIG. 663.—*Case* 2. Appearance of the hæmatoma exposed post mortem.

region without complete obstruction to the flow of the contrast medium.

Operation was not performed because of the poor general condition of the patient, and he died four days later.

A post-mortem examination revealed gross arteriosclerosis and an extensive extradural hæmatoma at the level of the seventh cervical vertebra (*Fig.* 663).

Case 3.—Mrs. N. C., aged 63 years, was admitted on Dec. 12, 1956. Three days previously she had been seized with sudden severe pain in the upper cervical region; the pain had radiated into her right shoulder, and was followed rapidly by weakness of the right arm, and later by weakness of the right leg. She had been admitted to a country hospital, and over the following two days paralysis increased, finally involving all four limbs. Examination revealed an elderly woman in marked respiratory distress due to paralysis of the accessory respiratory muscles. All four limbs were completely paralysed and there was marked impairment of all forms of sensation below the level of the third cervical segment. The systolic blood-pressure was 180 mm. Hg, and the diastolic 110 mm. Lumbar puncture revealed blood-stained cerebrospinal fluid at a pressure of 85 mm. of water, with no increase of pressure on jugular compression. The fluid contained 5300 red cells and 14 lymphocytes per c.mm., and a protein content of 178 mg. per cent.

Operation was performed immediately, the spinous processes and laminæ of the second, third, and fourth cervical vertebræ being removed. This revealed an extradural hæmatoma lying posteriorly and to the right of the neural canal. It extended from beneath the arch of the first cervical vertebra to below the level of the fourth cervical vertebra, and had caused considerable indentation of the underlying spinal cord. The hæmatoma was removed.

Immediately following operation her breathing temporarily improved, but subsequently deteriorated and she was maintained on controlled positive-pressure respiration through a tracheotomy incision until her death six days later. There had been no evidence of return of function of the affected spinal cord.

Post-mortem examination revealed generalized arteriosclerosis and softening of the cervical cord at the site of compression by the hæmatoma.

Case 4.—Mrs. B. D., aged 67 years, was admitted on June 9, 1956. Eight days prior to admission, while walking along the street, she was seized with severe pain in the centre of her dorsal spine. The pain was of violent intensity and she felt unable to walk; she was carried to a car and later walked with assistance from the car to her bed. The pain persisted in intensity and later intestinal stasis with abdominal distension and vomiting developed.

On admission to hospital, eight days after the onset of the pain, examination revealed an elderly woman, in severe pain, with abdominal distension, an overdistended bladder, muscular weakness of both lower limbs, and bilateral extensor response on plantar stimulation. Appreciation of all forms of sensation was unimpaired. The systolic blood-pressure was 220 mm. Hg, and diastolic 100 mm. Lumbar puncture revealed blood-stained cerebrospinal fluid at a pressure of 175 mm. of water. On jugular compression the pressure rose slowly to 260 mm., but did not fall on release of compression. The fluid contained 4600 red blood-cells per c.mm. The protein content was not measured.

Myelography revealed that pantopaque injected at the fourth lumbar space flowed regularly to the level of the eleventh thoracic vertebra, then divided into two

FIG. 664.—*Case* 4. Ascending myelogram. Complete obstruction of the opaque medium at the lower border of the ninth dorsal vertebra, with irregular filling defects over several vertebræ below this level.

lateral columns, and was completely obstructed at the level of the ninth thoracic vertebra (*Fig.* 664).

Operation was immediately performed, the spinous processes and laminæ of the eighth, ninth, and tenth thoracic vertebræ being removed. This did not reveal an extradural hæmatoma, but the dura mater was found to be grossly distended with blood and on incision of this membrane an extensive subdural and extra-arachnoid hæmatoma was revealed. The hæmatoma extended for some distance both cranially and caudally, but was easily removed by irrigation and suction.

After removal of the hæmatoma the arachnoid was seen to be considerably thickened but intact.

Operation was followed by relief of pain and rapid recovery of motor power of the lower limbs; she remained unable to pass urine normally for two weeks, but subsequently completely recovered.

DIFFERENTIAL DIAGNOSIS

In each case pain of intense severity developed with dramatic suddenness which suggested a vascular cause for the symptoms. The age of the patient, the presence of arteriosclerosis, and the absence of trauma suggested spontaneous hæmorrhage from an arteriosclerotic vessel. Radiology of the spinal column excluded collapse of a vertebra due to involvement by malignant disease and the findings on lumbar puncture are significant.

In each case evidence of an incomplete or complete block of the flow of cerebrospinal fluid was present, the protein content was considerably raised, and in 3 cases the presence of red blood-cells in the cerebrospinal fluid suggested a vascular lesion.

Myelography shows an irregularity of the column of opaque medium difficult to explain by any other condition. An extradural abscess may produce a similar appearance on myelography, but the onset of symptoms is less dramatic in this disease.

Differentiation from other vascular lesions may be difficult. Over the same period of time 3 patients suffering from paraplegia due to angiomatous malformations of the spinal cord have been admitted to the neurosurgical department. In 2 of these patients the development of paraplegia had been slowly progressive, but the third patient presented with symptoms almost indistinguishable from those of compression by an extradural hæmatoma.

Mr. G. C., aged 32 years, while walking along the street was suddenly seized with severe pain in the left side of the chest and back of the neck. Immediately he lost control of the lower limbs and of the left arm. Examination revealed a young man in extreme pain, with complete paralysis of the left lower limb and incomplete paralysis of the right lower limb and left arm. Radiography of the spinal column showed no abnormality, lumbar puncture revealed blood-stained cerebrospinal fluid at a pressure of 170 mm. of water and a normal response to jugular compression. Myelography revealed the typical radiological appearance of an angiomatous malformation involving the spinal cord in the lower cervical region.

This case is recorded to emphasize that similarity of symptoms may be due to hæmorrhage from an angiomatous malformation; this condition should be strongly suspected in the younger age group and in the absence of hypertension.

Differentiation from one other condition proved impossible.

Mr. E. Y., aged 68 years, was admitted on Nov. 17, 1955. Twenty-four hours prior to admission, while shaving, he was seized with a sudden violent pain at the level of the first dorsal vertebra. He retired to bed and some hours later found he could not pass urine, nor move his lower limbs. Examination twenty-four hours after the onset of pain revealed an elderly man with an almost complete paralysis of both lower limbs, an over-distended bladder, and marked loss of appreciation of all forms of sensation below the level of the first thoracic segment. Lumbar puncture revealed clear cerebrospinal fluid at a pressure of 110 mm. of water, with only slight rise of pressure on jugular compression; 100 lymphocytes were present in 1 c.mm. of cerebrospinal fluid and the protein content was 134 mg. per cent.

Myelography revealed obstruction of the column of pantopaque at the level of the third dorsal vertebra.

On this history and clinical findings a diagnosis of spontaneous extradural hæmorrhage was confidently made, but at operation an extensive thrombosis of a large extradural vein at the level of the first dorsal vertebra was disclosed, together with a pre-existing well-established adhesive arachnoiditis. It is considered that the latter condition was responsible for the obstruction as shown by lumbar puncture and myelography, and that the acute onset of pain and the subsequent paraplegia were due to the venous thrombosis.

Following operation the altered sensory function completely returned to normal, and he slowly regained a considerable degree of muscular power of the lower limbs and control of micturition.

TREATMENT

Paraplegia due to acute compression of the spinal cord must be regarded as a surgical emergency necessitating operative removal of the cause of compression as soon as possible. Recovery after operation from paraplegia due to slowly increasing compression of the spinal cord can be gratifying, but any delay in treatment for acute lesions is indefensible.

The site of the pain is the site of the lesion; the dramatic onset is suggestive of a vascular cause; confirmation of the diagnosis by radiography, lumbar puncture, and if necessary myelography, should be a rapid procedure, and operation should be performed with a minimum of delay.

Two of the three patients subjected to operation obtained no recovery of function, but treatment would probably have been more rewarding if operation had been performed earlier.

SUMMARY

Four patients with paraplegia due to compression of the spinal cord by a spontaneous extradural or subdural hæmatoma are presented. Study of the symptoms presents a similarity of pattern which should lead to a correct diagnosis being strongly suspected.

Two other case histories are presented to emphasize some difficulties in diagnosis.

The lesion is obviously less uncommon than the paucity of reference to it in the literature would lead one to believe.

The condition is one which warrants immediate investigation and operation before irreversible changes have occurred in the underlying spinal cord.

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BOOK NOTICES

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest to our readers.]

Endocrine Aspects of Breast Cancer. Proceedings of a Conference held at the University of Glasgow, 8th–10th July, 1957. Edited by ALASTAIR R. CURRIE, B.Sc., M.B., F.R.C.P. (Ed.), Senior Lecturer in Pathology, University of Glasgow; Consultant Pathologist, Royal Infirmary, Glasgow. With a Foreword by C. F. W. ILLINGWORTH, C.B.E., M.B., Ch.M., F.R.C.S. (Ed.), F.R.F.P.S., Regius Professor of Surgery, University of Glasgow. 8¾ × 5¾ in. Pp. 340+xvi, with 7 figures. 1958. Edinburgh: E. & S. Livingstone Ltd. 37s. 6d.

Frazer's Anatomy of the Human Skeleton. Edited by A. S. BREATHNACH, M.D., M.Sc., Senior Lecturer in Anatomy, St. Mary's Hospital Medical School, London. Fifth edition. 11¼ × 7¾ in. Pp. 247+viii, with 197 illustrations, many in colour. 1958. London: J. & A. Churchill Ltd. 50s.

Surgery of Head and Neck Tumors. By HAYES MARTIN, M.D., Attending Surgeon, Memorial Hospital, Associate Professor of Clinical Surgery, Cornell University Medical College, New York. 10½ × 7½ in. Pp. 430+xvi, with 599 illustrations. 1958. London: Cassell and Co. Ltd. £6 17s. 6d.

Cancer. Edited by RONALD W. RAVEN, O.B.E. (Mil.), T.D., F.R.C.S., Joint Lecturer in Surgery, Westminster Medical School, University of London. Volume 1. Pp. 539+x, with 94 illustrations. Volume 2. Pp. 641+x, with 357 illustrations. 1958. London: Butterworth & Co. (Publishers) Ltd. 85s. per volume.

The Year Book of General Surgery. Edited by MICHAEL E. DEBAKEY, B.S., M.D., M.S., Professor of Surgery and Chairman, Cova and Webb Mading Department of Surgery, Baylor University College of Medicine. With a section on Anæsthesia edited by STUART CULLEN, M.D. 7½ × 5 in. Pp. 560, with 128 illustrations. 1957. Chicago: The Year Book Publishers Inc. (London: Interscience Publishers Ltd.) 57s.

A Contribution to the Study of Portal Hypertension. By ALAN HENDERSON HUNT, M.A., D.M., M.Ch., F.R.C.S., Surgeon, St. Bartholomew's Hospital, and the Royal Marsden Hospital; Late Hunterian Professor, Royal College of Surgeons of England. 9¾ × 6½ in. Pp. 230+xii, with 119 illustrations. 1958. Edinburgh and London: E. & S. Livingstone Ltd. 40s.

An Introduction to Experimental Surgical Studies. By W. J. DEMPSTER, F.R.C.S., Lecturer in Experimental Surgery, Postgraduate Medical School of London. 9 × 5⅝ in. Pp. 463, with 72 illustrations. 1957. Oxford: Blackwell Scientific Publications. 50s.

Connective Tissue. A Symposium organized by The Council for International Organizations of Medical Sciences. Edited by R. E. TUNBRIDGE, The University of Leeds. 9 × 5¾ in. Pp. 371+xii, illustrated. 1957. Oxford: Blackwell Scientific Publications. 42s.

Bilateral Polycystic Disease of the Kidneys. A follow-up of two hundred and eighty-four patients and their families. By O. Z. DALGAARD. Translated from the Danish by HARRY COWAN, B.Sc. 9½ × 6⅞ in. Pp. 255, with 39 figures. 1957. Copenhagen: Ejnar Munksgaard.

Duodénum et Pancréas. Edited by GUY ALBOT, Physician at the Hôtel-Dieu, and F. POILLEUX, Surgeon, of the Corentin-Celton Hospital. 10 × 6¾ in. Pp. 296, with 126 illustrations. 1957. Paris: Masson. 3500 fr.

Pathologie et Chirurgie des Carotides. By GEORGES ARNULF, Assistant Professor, Associé National de l'Académie de Chirurgie. 9¾ × 6½ in. Pp. 544+viii, with 154 illustrations. 1957. Paris: Masson. 6800 fr.

Technique Chirurgicale Infantile. By BERNARD DUHAMEL, Assistant Professor of Surgery, Hospital of Saint-Denis, with the collaboration of SIMONE SEGAUX. 9¼ × 6½ in. Pp. 354, with 289 illustrations. 1957. Paris: Masson. 3500 fr.

Traitment Chirurgical de la Recto-Côlite Ulcéro-Hémorragique. By E. DELANNOY, Professor of Clinical Medicine, The Faculty of Medicine, Lille; and M. MARTINOT, Lille. 9¼ × 6¼ in. Pp. 120, with 26 illustrations. 1957. Paris: Masson. 1400 fr.

British Surgical Practice, 1957. Edited by SIR ERNEST ROCK CARLING, LL.D., F.R.C.S., F.R.C.P., F.F.R., Consulting Surgeon; and SIR JAMES PATERSON ROSS, K.C.V.O., LL.D., M.S., F.R.C.S., F.R.A.C.S., F.A.C.S., Director of Surgical Clinical Unit, St. Bartholomew's Hospital. 9¾ × 6½ in. Pp. 442+viii, with 48 illustrations. 1958. London: Butterworth & Co. (Publishers) Ltd. 52s. 6d.

Operative Surgery. Edited by CHARLES ROB, M.C., M.Chir., F.R.C.S., Professor of Surgery, St. Mary's Hospital, London; RODNEY SMITH, M.S., F.R.C.S., Surgeon, St. George's Hospital, London. Volume 6. Part X Hand, Pp. 105+x, Part XI Amputations, Pp. 71; Part XII Plastic Surgery, Pp. 131; Part XIII Gynaecology and Obstetrics, Pp. 123. Fully illustrated. 1958. London: Butterworth & Co. (Publishers) Ltd. £5 10s.

Recent Advances in Oto-Laryngology. By F. BOYES KORKIS, M.B., Ch.B. (N.Z.), D.L.O. (Eng.), F.R.C.S., Surgeon and Dean, Metropolitan Ear, Nose and Throat Hospital; Senior Consultant Oto-laryngologist, Hillingdon Hospital. With a Foreword by R. SCOTT STEVENSON, M.D., F.R.C.S. (Ed.). Third edition. 8¼ × 5¼ in. Pp. 438+x, with 2 coloured plates and 144 text-figures. 1958. London: J. & A. Churchill Ltd. 60s.

Ideals in Medicine. A Christian approach to medical problems. Edited by VINCENT EDMUNDS, M.D., M.R.C.P., and C. GORDON SCORER, M.B.E., M.D., F.R.C.S. 8½ × 5½ in. Pp. 192. 1958. London: The Tyndale Press. 12s. 6d.